United States Environmental Protection Agency
Region 9

In the Matter of :	
Iron Mountain Mine	Order No. 97-16
Iron Mountain Mines, Inc., T.W. Arman, Rhone-Poulenc, Inc.	
Respondents	
Proceeding under Section 106 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986, (42 U.S.C. § 9606)	

ADMINISTRATIVE ORDER
FOR REMEDIAL DESIGN, REMEDIAL ACTION, OPERATION AND MAINTENANCE

I. INTRODUCTION AND JURISDICTION

1. This Order directs Respondents to design, construct and operate and maintain the remedy selected in the September 30, 1997 Record of Decision (the 1997 ROD or "ROD4") for the Iron Mountain Mine Superfund Site ("IMM" or the "Site"); to operate and maintain the high density sludge/aerated simple mix ("HDS/ASM") lime neutralization treatment plant as modified pursuant to ROD4; to operate and maintain all remedial actions completed by Respondents pursuant to this Order; and to otherwise comply with the provisions of Orders 90-08, 91-07, 93-01 and 94-12. This Order is issued to Respondents by the United States Environmental Protection Agency ("EPA") under the authority vested in the President of the United States by Section 106(a) of the Comprehensive Environmental Response, Compensation, and

Liability Act of 1980, as amended ("CERCLA"), 42 U.S.C. § 9606(a). This authority was delegated to the Administrator of EPA on January 23, 1987, by Executive Order 12580 (52 Fed. Reg. 2926, January 29, 1987), and was further delegated to EPA Regional Administrators on September 13, 1987 by EPA Delegation No. 14-14-B. The Regional Administrator has redelegated this authority to the Director, Superfund Division. Except as expressly specified herein, this action does not alter any of the deadlines or obligations in any other order issued by EPA in connection with the Iron Mountain Mine Superfund Site.

II. FINDINGS OF FACT

2. This Order incorporates by reference the Findings of Fact contained in Orders No. 89-18, 90-08, 91-07, 92-26, 93-01, and 94-12 and related amendments.

3. On September 8, 1983, pursuant to section 105 of CERCLA, 42 U.S.C. § 9605, EPA placed the Iron Mountain Mine Site on the National Priorities List, set forth at 40 C.F.R. Part 300, Appendix B.

4. To study and undertake response activities in phases, EPA has divided the Site into separate operable units. The operable units addressed in prior Records of Decision include the general site-wide operable unit (the 1986 ROD or "ROD1"), the Boulder Creek operable unit (the 1992 ROD or "ROD2"), and the Old/No 8 Mine Seep operable unit (the 1993 ROD or "ROD3").

5. Past remedial actions at the Site include clean water diversions at Spring Creek and Slickrock Creek; partial caps; collection and conveyance of AMD from the Lawson Portal, Richmond Portal and Old/No 8 Mine Seep to the Minnesota Flats treatment plant for treatment; construction and on-going operation of an HDS/ASM lime neutralization treatment plant and related facilities; construction and operation of the Brick Flat Pit sludge disposal facility; and the excavation, consolidation and capping of several large pyrite waste piles in an on-site disposal cell.

6. EPA commenced a Remedial Investigation for the Slickrock Creek area in 1983, pursuant to CERCLA and the National Contingency Plan, 40 C.F.R. Part 300. EPA issued its Water Management Feasibility Study ("FS") in 1994, and the Water Management Feasibility Study Addendum in 1996.

7. Pursuant to section 117 of CERCLA, 42 U.S.C. § 9617, EPA published notice of the completion of the Water Management FS and of the proposed plan for remedial action in June, 1994, and provided opportunity for public comment on the proposed remedial action. Based on the comments received, EPA deferred final selection of the remedy to perform further studies of alternative remedial approaches. After conducting additional studies and investigations, EPA revised its proposed remedial approach. EPA published notice of the completion of the Water Management FS Addendum and of the revised proposed plan for remedial action in May, 1996, and provided opportunity for public comment on the proposed remedial action.

8. On September 30, 1997, EPA signed ROD4, which selects a remedy to collect and treat releases of hazardous substances from area-wide sources in the Slickrock Creek watershed at Iron Mountain. ROD4, included as Attachment A to this Order, is hereby incorporated by reference. ROD4 is supported by an administrative record that contains the documents and information upon which EPA based the selection of the response action. The State concurs with the remedy selected in ROD4.

9. The primary releases addressed in ROD4 and this Order are the area source AMD discharges from the portion of Slickrock Creek watershed that is highly disturbed by mining activities. Mining disturbances in this area of the mine property include but are not limited to the numerous voluminous waste piles; disturbed areas related to surface, side-hill and open pit mining activity; underground mine workings; groundwater and interflow seepage contaminated by mining activity; and underground pyritic mineralization exposed through mining-induced hydrologic and physical changes that vastly increases the rates of oxidation of

the in-place sulfide mineralization over naturally occurring, undisturbed conditions and the consequent release of hazardous substances. The releases from these sources consist of highly acidic, heavy metal-bearing waters, termed acid mine drainage or AMD. EPA estimates that the Slickrock Creek area sources account for approximately 60 to 70 percent of the copper load and 40 to 50 percent of the zinc and cadmium load associated with current uncontrolled Site discharges.

10. The heavy metals contained in the AMD from Slickrock Creek area sources include hazardous substances such as copper, cadmium, and zinc. The concentrations of copper, cadmium, and zinc in the AMD are toxic to aquatic life and harmful to humans. The AMD also contains acidity that is toxic to aquatic life and harmful to humans.

11. Surface water is the primary exposure pathway for AMD discharges from the Slickrock Creek area sources. The principal environmental threat posed by the releases from the Slickrock Creek area sources is the creation of conditions toxic to aquatic life in the receiving waters downstream of the Site.

12. The surface waters in the Spring Creek drainage affected by the Slickrock Creek area sources (Slickrock Creek, Spring Creek, and the Spring Creek Reservoir ("SCR")) are essentially devoid of aquatic life as a result of releases of hazardous substances from the Site.

13. Currently the SCR is relied on to meter the Spring Creek watershed surface waters, contaminated by the continuing uncontrolled IMM AMD area source discharges, into the Sacramento River at Keswick Reservoir. The SCR, coupled with the prior CERCLA response actions implemented pursuant to ROD1, ROD2 and ROD3, provides some degree of protection to aquatic resources and public health below the SCR, but IMM AMD discharges continue to harm and pose risks to aquatic resources and human health in Keswick Reservoir and the Sacramento River (particularly during certain storm events when discharges from the Site are greatest). Even taking into account the response actions implemented to date

(which have reduced site-wide releases by approximately 80 to 90 percent on average over the past several years), IMM AMD causes: (1) the receiving waters above the Spring Creek Debris Dam ("SCDD") to be essentially devoid of aquatic life; (2) regular exceedances of protective water quality standards and criteria in Keswick Reservoir; (3) continued exceedances of the protective water quality standards and criteria in the Sacramento River below Keswick Dam under certain storm conditions; and (4) the continued release of 25,000 to 70,000 pounds per year of copper and 40,000 to 90,000 pounds of zinc to Keswick Reservoir and the main stem of the Sacramento River in normal to wet water years. The remaining uncontrolled Site discharges of AMD are one to three times the metal load of all industrial discharges to the Sacramento River, San Francisco Bay and Delta combined.

14. Just below the point at which IMM AMD enters the main stem of the Sacramento River, the Sacramento River supports a valuable fishery that includes four species of chinook salmon, steelhead, and resident trout. The Winter-Run Chinook Salmon has been designated as an endangered species under the Endangered Species Act. The Sacramento River steelhead are currently being considered for listing under that statute. The Spring Run Chinook Salmon are also impaired and have been designated as a candidate for listing as threatened or endangered under the California Endangered Species Act. All of these species are particularly sensitive to toxic heavy metals such as copper, cadmium, and zinc. The National Oceanic and Atmospheric Administration ("NOAA") has identified the affected area as the most important salmon habitat in California.

15. Aquatic resources also exist in Keswick Reservoir. These aquatic resources include resident trout and populations of numerous benthic organisms. The aquatic resources in Keswick Reservoir are also adversely affected by the continued AMD releases from the Site.

16. Releases of hazardous substances from the Site also pose a threat to human health. The Sacramento River below the influence

of Iron Mountain serves as a source of drinking water for the City of Redding. Under current conditions, exceedances of drinking water criteria below Keswick Dam for heavy metals are expected to be quite rare. Humans can be harmed by direct exposure to the highly acidic and metal-laden AMD. Under current conditions, the potential for direct human exposure to AMD is relatively small due to control of site access, but direct contact is still possible. Ingestion of resident trout in the area of the IMM AMD discharges poses a small threat due to the bioaccummulation of cadmium. Also, the AMD discharges result in the deposition of heavy metal sediments in areas which may present a small but identifiable threat to human health from potential ingestion and inhalation.

17. Several large hematite mine waste piles exist in the Slickrock Creek basin. The hematite piles contain levels of arsenic that require remediation under state mining laws. The hematite piles are actively eroding into Slickrock Creek and to downstream areas. The erosion of this material poses a potential threat to the environment and human health. The erosion of the hematite pile is also anticipated to interfere with the operation and maintenance of the retention pond to be constructed pursuant to ROD4.

18. Actual or threatened releases of AMD from the Slickrock creek watershed, if not addressed by implementing appropriate response actions, may present an imminent and substantial endangerment to human health or the environment.

19. The remedy selected in ROD4 includes the construction of a retention dam in Slickrock Creek, surface water diversion facilities, hematite erosion control facilities, sedimentation basins or control structures, AMD conveyance systems, modifications to the HDS/ASM lime neutralization treatment plant, and a treated water discharge tunnel; disposal of treatment sludges on-site in the sludge disposal facility in Brick Flat Pit; and performance of long-term operation and maintenance. The selected remedy is described in greater detail in the Attachment

A to this Order (ROD4).

20. The selected response action for the Slickrock Creek area source AMD discharges is expected to make significant progress toward abating the imminent and substantial endangerment to human health and the environment caused by the continuing AMD discharges from the IMM area sources. The action will remove a significant load of toxic metals that would otherwise be released into the environment. The removal of these metals will improve water quality, improve the ability to permit controlled release and dilution of IMM AMD under storm conditions. The removal of these metals is also expected to restore at least some of the beneficial uses to a portion of the Spring Creek watershed. The remedy selected in ROD4 is an interim remedy that does not address all remaining releases of hazardous substances from the Site.

21. The Respondents identified below in this paragraph are collectively referred to as "Respondents."

A. T.W. Arman and Iron Mountain Mines, Inc. ("IMMI"), Respondents, are the current owners and operators of Iron Mountain Mines, and have been the owners and operators since about December, 1976.

B. Rhone-Poulenc, Inc., ("RP"), Respondent, a New York corporation, is the legal successor to Mountain Copper Co., Ltd., Stauffer Chemical Co.("Stauffer"), and Rhone-Poulenc Basic Chemicals Co., Inc. Mountain Copper and Stauffer were owners and operators of the facility at the time of disposal of hazardous substances. Rhone-Poulenc Basic Chemicals was the successor to Mountain Copper and Stauffer. Rhone-Poulenc Basic was merged into Rhone-Poulenc, Inc., effective December 31, 1992.

III. CONCLUSIONS OF LAW AND DETERMINATIONS

22. The Iron Mountain Mine Site is a "facility" as defined in section 101(9) of CERCLA, 42 U.S.C. § 9601(9).

23. Respondents are "persons" as defined in section 101(21) of CERCLA, 42 U.S.C. § 9601(21).

24. Respondents are "liable parties" as defined in section 107(a) of CERCLA, 42 U.S.C. § 9607(a), and are subject to this Order under section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

25. The substances listed in paragraph 8 are found at the Site and are "hazardous substances" as defined in section 101(14) of CERCLA, 42 U.S.C. § 9601(14).

26. These hazardous substances have been released, are being released and threaten to continue to be released from the Site into surface waters.

27. The spilling, leaking, pouring, emitting, emptying, discharging, escaping, leaching, dumping or disposing, of hazardous substances from the Site are a "release" as defined in section 101(22) of CERCLA, 42 U.S.C. § 9601(22).

28. The potential for future leaching, migration and release of hazardous substances from the Site poses a threat of a "release" as defined in section 101(22) of CERCLA, 42 U.S.C. § 9601(22).

29. The release of the hazardous substances from the facility may present an imminent and substantial endangerment to the public health or welfare or the environment.

30. The contamination and endangerment being addressed in ROD4 constitute an indivisible injury. The actions required by this Order are necessary to protect the public health, welfare, and the environment.

IV. NOTICE TO THE STATE

31. Prior to issuing this Order, EPA notified the State of California Department of Toxic Substances Control, that EPA would be issuing this Order.

V. ORDER

32. Based on the foregoing, Respondents are hereby ordered, jointly and severally, to comply with the provisions of this Order, including but not limited to all attachments to this Order, all documents incorporated by reference into this Order, and all schedules and deadlines in this Order, attached to this

Order, or incorporated by reference into this Order.

VI. DEFINITIONS

33. Unless otherwise expressly provided herein, terms used in this Order which are defined in CERCLA or in regulations promulgated under CERCLA shall have the meaning assigned to them in the statute or its implementing regulations. Whenever terms listed below are used in this Order or in the documents attached to this Order or incorporated by reference into this Order, the following definitions shall apply:

a. "CERCLA" shall mean the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. §§ 9601 et seq.

b. "Day" shall mean a calendar day unless expressly stated to be a working day. "Working day" shall mean a day other than a Saturday, Sunday, or Federal holiday. In computing any period of time under this Order, where the last day would fall on a Saturday, Sunday, or Federal holiday, the period shall run until the end of the next working day.

c. "EPA" shall mean the United States Environmental Protection Agency.

d. "DTSC" shall mean the State of California, Department of Toxic Substances Control.

e. "National Contingency Plan" or "NCP" shall mean the National Contingency Plan promulgated pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605, codified at 40 C.F.R. Part 300, including any amendments thereto.

f. "Operation and Maintenance" or "O&M" shall mean all activities required under the Operation and Maintenance Plan developed by Respondents pursuant to this Order and Section 8 of the Statement of Work, and approved by EPA.

g. "Order" shall mean a unilateral order and all amendments thereto.

h. "Paragraph" shall mean a portion of this Order identified by an Arabic numeral and its sub-parts.

i. "Performance Standards" shall mean those cleanup standards, standards of control, and other substantive requirements, objectives, criteria or limitations, identified in the Record of Decision and Statement of Work, that the Remedial Action and Work required by this Order must attain and maintain.

j. "Record of Decision" or "ROD" or "1997 ROD" or "ROD4" shall mean the EPA Record of Decision relating to the Site signed on September 30, 1997 by the Director, Superfund Division, U.S. EPA Region IX, and all attachments thereto.

k. "Remedial Action" or "RA" shall mean those activities to be undertaken by Respondents to implement the final plans and specifications for all facilities, structures or equipment to be constructed, erected or installed submitted by Respondents pursuant to the EPA approved Project Delivery Analysis ("PDA") to implement the remedy selected in ROD4 for the Site, and including any additional activities required under Sections X, XI, XII, XIII, and XIV of this Order. Notwithstanding the preceding sentence, the term "Remedial Action" or "RA" shall not include Operation and Maintenance.

l. "Remedial Design" or "RD" shall mean those activities to be undertaken by Respondents pursuant to the EPA approved PDA to develop the final plans and specifications for all facilities, structures or equipment to be constructed, erected or installed to implement the remedy selected in ROD4 for the Site.

m. "Response Costs" shall mean all costs, including direct costs, indirect costs, and accrued interest incurred by the United States and the State to perform or support response actions at the Site. Response costs include but are not limited to the costs of overseeing the Work, such as the costs of reviewing or developing plans, reports and other items pursuant to this Order and costs associated with verifying the Work.

n. "Statement of Work" or "SOW" shall mean the statement of work for implementation of the Remedial Design, Remedial Action, and Operation and Maintenance at the Site, as set forth in Attachment B to this Order. The Statement of Work is

incorporated into this Order and is an enforceable part of this Order.

o. "Section" shall mean a portion of this Order identified by a Roman numeral and includes one or more paragraphs.

p. "Site" shall mean the Iron Mountain Mine Superfund site, encompassing the approximate 4400 acre mine property located approximately 9 miles northwest of the City of Redding, in Shasta County, California, and the downstream areas where hazardous substances have come to be located, as described in ROD4.

q. "State" shall mean the State of California.

r. "United States" shall mean the United States of America.

s. "Work" shall mean all activities Respondents are required to perform under this Order to implement ROD4 for the Slickrock Creek area sources, including Remedial Design, Remedial Action and Operation and Maintenance, and all other activities required to be undertaken pursuant to this Order.

VII. NOTICE OF INTENT TO COMPLY

34. Not later than twenty (20) days after the date this Order is signed, Respondents shall provide written notice to EPA's Remedial Project Manager ("RPM") stating whether they will comply with the terms of this Order. If Respondents do not unequivocally commit to perform the RD, RA and O&M as provided by this Order, they shall be deemed to have violated this Order and to have failed or refused to comply with this Order. Respondents' written notice shall describe, using facts that exist on or prior to the effective date of this Order, any "sufficient cause" defenses asserted by Respondents under sections 106(b) and 107(c)(3) of CERCLA. The absence of a response by EPA to the notice required by this paragraph shall not be deemed to be acceptance of Respondents' assertions.

VIII. PARTIES BOUND

35. This Order shall apply to and be binding upon each of the Respondents identified in paragraph 21, their directors,

officers, employees, agents, successors, and assigns. Respondents are jointly and severally responsible for carrying out all activities required by this Order. No change in the ownership, corporate status, or other control of any Respondents shall alter any of the Respondents' responsibilities under this Order.

36. Respondents shall provide a copy of this Order to any prospective owners or successors before a controlling interest in Respondents' assets, property rights, or stock is transferred to the prospective owner or successor. Respondents shall provide a copy of this Order to each contractor, sub-contractor, laboratory, or consultant retained to perform any Work under this Order, within five days after the effective date of this Order or on the date such services are retained, whichever date occurs later. Respondents shall also provide a copy of this Order to each person representing any Respondents with respect to the Site or the Work and shall condition all contracts and subcontracts entered into hereunder upon performance of the Work in conformity with the terms of this Order. With regard to the activities undertaken pursuant to this Order, each contractor and subcontractor shall be deemed to be related by contract to the Respondents within the meaning of section 107(b)(3) of CERCLA, 42 U.S.C. § 9607(b)(3). Notwithstanding the terms of any contract, Respondents are responsible for compliance with this Order and for ensuring that their contractors, subcontractors and agents comply with this Order, and perform any Work in accordance with this Order.

37. Within five (5) days after the effective date of this Order each Respondent that owns real property comprising all or part of the Site shall record a copy or copies of this Order in the appropriate governmental office where land ownership and transfer records are filed or recorded. Respondents shall, within 15 days after the effective date of this Order, send notice of such recording and indexing to EPA.

38. Not later than sixty (60) days prior to any transfer of any real property interest in any property included within the Site, Respondents shall submit a true and correct copy of the transfer documents to EPA, and shall identify the transferee by name, principal business address and effective date of the transfer.

IX. WORK TO BE PERFORMED

Public Information and Meetings

39. Respondents shall cooperate with EPA in providing information regarding the Work to the public. As requested by EPA, Respondents shall participate in the preparation of such information for distribution to the public and in public meetings which may be held or sponsored by EPA to explain activities at or relating to the Site.

State Participation

40. Respondents shall submit copies of documents submitted pursuant to this section for EPA review to DTSC at the same time the documents are submitted to EPA. The State shall have the right to participate in all meetings required by this section.

Enforceability

41. All documents approved by EPA under this section shall become enforceable provisions of this Order and non-compliance with any approved document will be subject to penalties in the same manner as any other violation of this Order.

42. The Respondents shall design, construct, operate and maintain all facilities, structures or equipment to be constructed, modified, erected or installed to implement the remedy selected in ROD4 for the Site in accordance with the requirements of ROD4 (Attachment A to this Order), the Scope of Work contained in Attachment B to this Order, and as outlined in this Order.

Project Manager

43. All aspects of the Work to be performed by Respondents pursuant to this Order shall be under the direction and supervision of a qualified project manager. The selection of the

project manager shall be subject to approval by EPA. Within 5 days after the effective date of this Order, Respondents shall notify EPA in writing of the name and qualifications of the project manager, including primary support entities and staff, proposed to be used in carrying out Work under this Order. If at any time Respondents propose to use a different project manager, Respondents shall notify EPA and shall obtain approval from EPA before the new project manager performs any Work under this Order.

44. EPA will review Respondents' selection of a project manager according to the terms of this paragraph and Section XIV of this Order. If EPA disapproves of the selection of the project manager, Respondents shall submit to EPA within 30 days after receipt of EPA's disapproval of the project manager previously selected, a list of project managers, including primary support entities and staff, that would be acceptable to Respondents. EPA will thereafter provide written notice to Respondents of the names of the project managers that are acceptable to EPA. Respondents may then select any approved project manager from that list and shall notify EPA of the name of the project manager selected within twenty-one (21) days of EPA's designation of approved project managers.

Site Health And Safety Plans

45. Within thirty (30) days after the effective date of this Order, Respondents shall prepare and submit to EPA for review, a Site Health and Safety Plan for field design activities. The Site Health and Safety Plan shall conform to the applicable Occupational Safety and Health Administration and EPA requirements, including but not limited to 54 Fed. Reg. 9294.

46. Not later than 30 days after the date that EPA approves all deliverables required as part of a Final Design, Respondents shall submit to EPA for review, Health and Safety Plan for field activities required by the RA Work Plan. The Health and Safety Plan for field activities shall conform to applicable Occupational Safety and Health Administration and EPA

requirements, including but not limited to the regulations at 54 Fed. Reg. 9294.

Project Delivery Analysis

47. Within twenty-one (21) days after the effective date of this Order, the Respondents shall submit to EPA for review and approval a draft Project Delivery Analysis ("PDA"). The draft PDA shall fully conform with the provisions of this Order, ROD4 and the SOW in Attachment B. The draft PDA shall include a step-by-step plan for completing the Remedial Design and Remedial Action for the remedy selected in ROD4 and for attaining and maintaining all requirements, including but not limited to Performance Standards and project objectives identified in the SOW in Attachment B, ROD4 and all other requirements contained in this Order. The draft PDA shall describe in detail the tasks and deliverables Respondents will complete, and a schedule for completing the tasks and deliverables in the draft PDA. The major tasks and deliverables are described in the SOW in Attachment B of this Order. The schedule submitted in the draft PDA shall be consistent with the schedule provided in the SOW in Attachment B of this Order and shall provide for completion of the remedial action by October 1, 1999, unless that date is expressly extended by EPA. Within seven (7) days from the receipt of EPA's comments, the Respondents shall incorporate all EPA comments into the draft PDA and resubmit a draft final PDA for EPA review and approval. Upon approval of the draft final PDA by EPA, it becomes final. The final PDA shall be incorporated into this Order as a requirement of this Order and shall be an enforceable part of this Order.

48. The Respondents shall identify and detail in the draft PDA, draft final PDA, and PDA all time critical components for procurement and construction that require initiation prior to formal review of the prefinal plans and specifications. The Respondents shall develop in detail the design, design review, construction and scheduling requirements for these time-critical

components. The draft PDA, draft final PDA, and PDA shall provide for EPA review and approval of the preliminary, pre-final and final designs for each of these time-critical components. The final design submittals for these time-critical components shall include all plans specified for non-time-critical components.

49. Respondents shall implement the design and construction tasks for these time-critical project components pursuant to the approved PDA and schedule to enable procurement and construction in accordance with the necessary expedited schedule.

Work Planning Meetings

50. Respondents shall attend and participate in work planning meetings as set forth in the SOW in Attachment B and in other meetings as requested by EPA.

Preliminary Designs and Engineering Analysis Reports Submittals

51. In accordance with the schedule in the approved PDA, the Respondents shall submit, for EPA review and approval, Preliminary Designs and Engineering Analysis Reports as set forth in the SOW in Attachment B for each component of the remedy selected in ROD4. The Preliminary Designs and Engineering Analysis Reports submittal for each component shall include, at a minimum, all items listed in the attached SOW for that component of the remedial action.

52. In accordance with the schedule in the approved PDA, Respondents shall submit, for EPA review and approval, Intermediate Designs for each component of the remedy selected in ROD4. The Intermediate Design submittal for each component shall include, at a minimum, all items listed in the attached SOW for that component of the remedial action.

53. In accordance with the schedule in the approved PDA, Respondents shall submit, for EPA review and approval, the Prefinal and Final Designs for each component of the remedy selected in ROD4. The Prefinal and Final Design submittal for each component shall include, at a minimum, all items listed in the attached SOW for that component of the remedial action.

54. Upon EPA approval, the Final Design for each component of the remedy selected in ROD4 is incorporated into this Order as a requirement of this Order and shall be an enforceable part of this Order.

Remedial Action

55. After EPA approves all deliverables required as part of the Final Design for the Remedial Action (or in a phased implementation approach the final design for a component of the remedy selected in ROD4), Respondents shall expeditiously commence the Remedial Action (or the component remedial action) in accordance with the schedule in the approved PDA. Unless otherwise directed by EPA, Respondents shall not commence the Remedial Action (or in a phased implementation approach the remedial action for a component of the remedy selected in ROD4) at the Site prior to EPA approval of the Final Design (or the final design for that component of the remedial action).

56. If Respondents seek to retain a construction contractor to assist in the performance of the Remedial Action (or in a phased implementation approach, a component of the remedial action selected in ROD4) then Respondents shall submit a copy of the contractor solicitation documents for the remedial action (or the component remedial action) to EPA not later than five (5) days after publishing the solicitation documents.

57. Within 30 days after EPA approves the Final Design for the Remedial Action (or in a phased implementation approach, a component of the remedial action selected in ROD4), Respondents shall notify EPA in writing of the name, title, and qualifications of any construction contractor proposed to be used in carrying out work under this Order. EPA shall thereafter provide written notice of the name(s) of the contractor(s) it approves, if any. Respondents may select any approved contractor from that list and shall notify EPA of the name of the contractor selected within twenty-one (21) days of EPA's designation of approved contractors. If at any time Respondents proposes to change the construction contractor, Respondents shall notify EPA

and shall obtain approval from EPA as provided in this paragraph, before the new construction contractor performs any work under this Order. If EPA disapproves of the selection of any contractor as the construction contractor, Respondents shall submit a list of contractors that would be acceptable to them to EPA within thirty (30) days after receipt of EPA's disapproval of the contractor previously selected.

Performance Standards

58. The Work performed by Respondents pursuant to this Order shall, at a minimum, achieve the Performance Standards specified in the Record of Decision and the Statement of Work.

59. Notwithstanding any action by EPA, Respondents remain fully responsible for achievement of the Performance Standards in the Record of Decision and Statement of Work. Nothing in this Order, or in EPA's approval of any submission, shall be deemed to constitute a warranty or representation of any kind by EPA that full performance of the Remedial Design or Remedial Action will achieve the Performance Standards set forth in the ROD and the Statement of Work. Respondents' compliance with such approved documents does not foreclose EPA from seeking additional work to achieve the applicable performance standards.

Off-site Shipment

60. Respondents shall, prior to any off-site shipment of hazardous substances from the Site to an out-of-state waste management facility, provide written notification to the appropriate state environmental official in the receiving state and to EPA's RPM of such shipment of hazardous substances. However, the notification of shipments shall not apply to any off-Site shipments when the total volume of all shipments from the Site to the State will not exceed ten (10) cubic yards.

Completion of the Remedial Action

61. Within thirty (30) days after Respondents conclude that the Remedial Action has been fully performed, Respondents shall so notify EPA and shall schedule and conduct a pre-certification inspection to be attended by Respondents and EPA. The pre-

certification inspection shall be followed by a written report submitted within thirty (30) days of the inspection by a registered professional engineer and Respondents' Project Coordinator certifying that the Remedial Action has been completed in full satisfaction of the requirements of this Order. If, after completion of the pre-certification inspection and receipt and review of the written report, EPA determines that the Remedial Action or any portion thereof has not been completed in accordance with this Order, EPA shall notify Respondents in writing of the activities that must be undertaken to complete the Remedial Action and shall set forth in the notice a schedule for performance of such activities. Respondents shall perform all activities described in the notice in accordance with the specifications and schedules established therein. If EPA concludes, following the initial or any subsequent certification of completion by Respondents that the Remedial Action has been fully performed in accordance with this Order, EPA may notify Respondents that the Remedial Action has been fully performed. EPA's notification shall be based on present knowledge and Respondents' certification to EPA, and shall not limit EPA's right to perform periodic reviews pursuant to section 121© of CERCLA, 42 U.S.C. § 9621(c), or to take or require any action that in the judgment of EPA is appropriate at the Site, in accordance with 42 U.S.C. §§ 9604, 9606, or 9607.

62. Within thirty (30) days after Respondents conclude that all phases of the Work have been fully performed, and that the Performance Standards have been attained, the Respondents shall submit to EPA a written report by a registered professional engineer certifying that the Work has been completed in full satisfaction of the requirements of this Order. EPA shall require such additional activities as may be necessary to complete the Work or EPA may, based upon present knowledge and Respondents' certification to EPA, issue written notification to Respondents that the Work has been completed, as appropriate, in accordance with the procedures set forth in Paragraph 61 for

Respondents' certification of completion of the Remedial Action. EPA's notification shall not limit EPA's right to perform periodic reviews pursuant to section 121© of CERCLA, 42 U.S.C. § 9621(c), or to take or require any action that in the judgment of EPA is appropriate at the Site, in accordance with 42 U.S.C. §§ 9604, 9606, or 9607.

Operation and Maintenance

63. No later than 60 days prior to the completion of construction of the capital projects required by the Order, the Respondents shall submit a draft Operations and Maintenance Manual ("O&M Manual") for review and approval by EPA. The draft O&M Manual shall provide a comprehensive plan for operation, maintenance and inspection of: (i) the modified IMM HDS/ASM lime neutralization treatment plant, treated water discharge tunnel, sludge drying beds, sludge disposal facilities, and all related facilities; (ii) the AMD conveyance system and related facilities; (iii) the Slickrock Creek retention reservoir, outlet works, clean water diversions, sedimentation basins or control structures, hematite containment structure, and related facilities; and (iv) the access roadways and all other facilities and activities related to this Order. Within 21 days of receipt of written EPA comments, the Respondents shall incorporate the EPA comments into a draft final O&M Manual and submit the draft final O&M Manual for EPA review and approval. Upon approval of the draft final O&M Manual by EPA, it becomes final. The final O&M Manual shall be incorporated into this Order as a requirement of this Order and shall be an enforceable part of this Order. If Respondents complete the project by constructing components of the remedial action selected in ROD4 in phases, EPA may require Respondents to submit for review and approval a draft and draft final O&M Manual for each component of the remedy.

64. Respondents shall submit a draft Startup/Shakedown Work Plan, for EPA review and approval, for the startup and shakedown of the modified IMM HDS/ASM lime neutralization treatment plant and related facilities. The draft Startup/Shakedown Work Plan

shall define the work to be performed to assure that all facilities constructed or modified pursuant to this Order are performing as designed and to demonstrate that the modified IMM HDS/ASM treatment plant meets all performance standards of ROD4, this Order and the SOW (Attachment B). The draft Start-up/Shakedown Work Plan shall include a draft Performance Standards Verification Plan ("PSVP") that defines all tests to be performed (including a draft Sample and Analysis Plan ("SAP") and draft Quality Assurance Project Plan ("QAPP")) to demonstrate the performance of the modified HDS/ASM lime neutralization treatment plant facilities. The PDA, required pursuant to Paragraphs 47, 48 and 49 of this Order, and draft Startup/Shakedown Work Plan shall define the commencement of the "Startup/Shakedown Period" and the termination of Startup/Shakedown Period based upon the completion of successful performance testing. During the Startup/Shakedown Period, EPA will as appropriate use its enforcement discretion with respect to operational problems associated with the Startup/Shakedown Period, taking into account such factors as the degree to which Respondents operate the IMM HDS/ASM lime neutralization treatment plant and other facilities in a manner that conforms with the approved Operations and Maintenance Manual required pursuant to Paragraph 63 of this Order and otherwise meets the performance standards of ROD4, this Order and the SOW (Attachment B). Within seven (7) days from the receipt of EPA's comments, the Respondents shall incorporate all EPA comments on the draft Startup/Shakedown Work Plan (including the PSVP, SAP and QAPP) and resubmit a draft final Startup/Shakedown Work Plan for EPA review and approval. Upon approval of the draft final Startup/Shakedown Work Plan by EPA, it becomes final. The final Startup/Shakedown Work Plan shall be incorporated into this Order as a requirement of this Order and shall be an enforceable part of this Order.

65. Once EPA approves the O&M Manual, the Respondents shall operate and maintain the IMM HDS/ASM lime neutralization treatment plant and all other components of the Remedial Action

in accordance with the provisions of the approved O&M Manual. Until EPA approves the O&M Manual for the modified IMM HDS/ASM lime neutralization treatment plant, Respondents shall operate and maintain the treatment plant and all related components of the Remedial Action in accordance with existing O&M manuals and all other existing requirements.

66. In response to a major storm event or some other non-routine factor, EPA may request that Respondents submit, for EPA review and approval pursuant to Section XIV of this Order, draft designs and draft specifications, along with supporting engineering calculations and other information, to implement emergency O&M repairs that EPA has determined are appropriate. Respondents shall submit the emergency O&M deliverables within the time-frame specified by EPA. Upon approval by EPA, Respondents shall conduct the work necessary to perform the emergency operations and maintenance repairs. The provisions of this paragraph do not relieve respondents of the obligations imposed by any other provision of this or any other Order, including but not limited to Section XIII of this Order.

67. By April 1 of each year, Respondents shall submit, for EPA review and approval, a draft annual operations, maintenance and inspection work plan that will cover operations, maintenance and inspection activities planned for the 12-month period beginning on June 1 of that year. The draft work plan shall include all such activities related to remedial actions designed, constructed, modified, implemented, operated or maintained pursuant to Order Nos. 93-01, 94-12, and 97-16. The draft work plan shall: 1) provide detailed descriptions for each maintenance problem or repair item experienced in previous 12 month period, including but not limited to equipment or facility failures and storm damage to Site facilities, that require repair and the steps to be taken to remedy those problems; 2) provide draft designs and specifications for each proposed equipment or storm damage repair item, along with supporting engineering calculations and other information; and 3) identify and provide a

schedule for all routine inspections and maintenance activities to be performed. The following items are not subject to the reporting requirements contained in this Paragraph: (a) the replacement of belts on drives between motors and the equipment driven (e.g., lime slurry pumps and slaker drums); slaker screens; filters for water and oil; local level indicators on tanks and silos; hoses for lime transfer from trucks; pH probes; belt guards; light bulbs, and repairs to buildings and building equipment; and (b) maintenance tasks of remedying the pluggage of lime transfer piping caused by excess fines in the quicklime; removing rocks that fall and partially block the roads almost every time it rains; and repairing minor road erosion that does not interfere with road traffic or normal access.

68. Respondents shall incorporate EPA comments on the draft annual operations, maintenance and inspection work plan, including revisions to the draft repair designs and specifications, within twenty-one (21) days from the receipt of EPA's comments. Respondents shall submit the draft final annual operations, maintenance and inspection work plan to EPA for review and approval. Upon EPA approval, the draft final annual operations, maintenance and inspection work plan, including the draft repair designs and specifications, becomes final. The final annual operations, maintenance and inspection work plan, including the final repair designs and specifications, is incorporated into this Order as a requirement of this Order and shall be an enforceable part of this Order. Upon EPA approval of the annual operations, maintenance and inspection work plan, Respondents shall perform the approved operations, maintenance and inspection activities and expeditiously implement the approved repairs in accordance with the approved work plan. Unless otherwise directed by EPA, Respondents shall not commence any repair prior to EPA approval of the activity in the then-current annual operations, maintenance and inspection work plan. The provisions of this paragraph do not relieve Respondents of the obligations imposed by any other provision of this or any

other Order, including but not limited to Section XIII of this Order.

69. This Order hereby amends Section VI (B)(1.11) of Order 91-07 by changing the submission and review procedures for the annual inspection, operation and maintenance Work Plan for the O&M Units required pursuant to Order 91-07. Starting on January 1, 1998, Respondents shall integrate the draft annual operations, maintenance and inspection work plan required by Order 91-07 with the draft O&M report required by Order 97-16. By April 1 of each year, Respondents shall submit this integrated report to EPA for review and approval. This provision does not excuse past non-compliance with the requirements of Order 91-07 or any other order.

X. FAILURE TO ATTAIN PERFORMANCE STANDARDS

70. In the event that EPA determines that additional response activities are necessary to meet applicable Performance Standards, EPA may notify Respondents that additional response actions are necessary.

71. Unless otherwise directed by EPA, within thirty (30) days of receipt of notice from EPA that additional response activities are necessary to meet any applicable Performance Standards, Respondents shall submit for approval by EPA a work plan for the additional response activities. The plan shall conform to the applicable requirements of Sections IX, XVI, and XVII of this Order. Upon EPA's approval of the plan pursuant to Section XIV, Respondents shall implement the plan for additional response activities in accordance with the provisions and schedule contained therein.

XI. EPA PERIODIC REVIEW

72. Under section 121(c) of CERCLA, 42 U.S.C. § 9621(c), and any applicable regulations, EPA may review the Site to assure that the Work performed pursuant to this Order adequately protects human health and the environment. Until such time as EPA

certifies completion of the Work, Respondents shall conduct the requisite studies, investigations, or other response actions as determined necessary by EPA in order to permit EPA to conduct the review under section 121(c) of CERCLA. As a result of any review performed under this paragraph, Respondents may be required to perform additional Work or to modify Work previously performed.

XII. ADDITIONAL RESPONSE ACTIONS

73. EPA may determine that in addition to the Work identified in this Order and attachments to this Order, additional response activities may be necessary to protect human health and the environment. If EPA determines that additional response activities are necessary, EPA may require Respondents to submit a work plan for additional response activities. EPA may also require Respondents to modify any plan, design, or other deliverable required by this Order, including any approved modifications.

74. Not later than thirty (30) days after receiving EPA's notice that additional response activities are required pursuant to this Section, Respondents shall submit a work plan for the response activities to EPA for review and approval. Upon approval by EPA, the work plan is incorporated into this Order as a requirement of this Order and shall be an enforceable part of this Order. Upon approval of the work plan by EPA, Respondents shall implement the work plan according to the standards, specifications, and schedule in the approved work plan. Respondents shall notify EPA of their intent to perform such additional response activities within seven (7) days after receipt of EPA's request for additional response activities.

XIII. ENDANGERMENT AND EMERGENCY RESPONSE

75. Notwithstanding any other provision of this Order or any prior order, in the event of any action or occurrence during the performance of the Work which causes or threatens to cause a release of a hazardous substance or which may present an

immediate threat to public health or welfare or the environment, Respondents shall immediately take all appropriate action to prevent, abate, or minimize the threat, and shall immediately notify EPA's Remedial Project Manager ("RPM") or, if the RPM is unavailable, EPA's Alternate RPM. If neither of these persons is available Respondents shall notify the EPA Emergency Response Unit, Region 9. Respondents shall take such action in consultation with EPA's RPM, EPA's Alternate RPM or the EPA Emergency Response Unit, Region 9, and in accordance with all applicable provisions of this Order, including but not limited to the Health and Safety Plan and the Contingency Plan. In the event that Respondents fail to take appropriate response action as required by this Section, and EPA takes that action instead, Respondents shall reimburse EPA for all costs of the response action not inconsistent with the NCP. Respondents shall pay the response costs in the manner described in Section XXIV of this Order, within thirty (30) days of Respondents' receipt of demand for payment and a Regionally-prepared cost summary, which includes all direct and indirect costs incurred by EPA and the state and their contractors of the costs incurred.

76. Nothing in the preceding paragraph shall be deemed to limit any authority of the United States to take, direct, or order all appropriate action to protect human health and the environment or to prevent, abate, or minimize an actual or threatened release of hazardous substances on, at, or from the Site or to otherwise obtain any relief EPA deems appropriate.

XIV. EPA REVIEW OF SUBMISSIONS

77. After review of any deliverable, plan, report or other item which is required to be submitted for review and approval pursuant to this Order, EPA may: (a) approve the submission; (b) approve the submission with modifications; (c) disapprove the submission and direct Respondents to re-submit the document after incorporating EPA's comments; (d) disapprove the submission, modify the submittal, and direct Respondents to take specific

action related to the submission; or (e) disapprove the submission and assume responsibility for performing all or any part of the response action. As used in this Order, the terms "approval by EPA," "EPA approval," or a similar term means the action described in paragraphs (a) or (b) of this paragraph.

78. In the event of approval or approval with modifications by EPA, Respondents shall proceed to take any action required by the plan, report, or other item, as approved or modified by EPA.

79. Upon receipt of a notice of disapproval or a request for a modification, Respondents shall, within twenty-one (21) days or such other time as specified by EPA in its notice of disapproval or request for modification, correct the deficiencies and resubmit the plan, report, or other item for approval. Notwithstanding the notice of disapproval, or approval with modifications, Respondents shall proceed, at the direction of EPA, to take any action required by any non-deficient portion of the submission or any other related action required by EPA in its notice of disapproval or request for modification.

80. If any submission is not approved by EPA, Respondents shall be deemed to be in violation of this Order. In the event that EPA disapproves one or more submissions and assumes responsibility for performing all or any part of the Work, Respondents shall remain fully responsible for implementing all aspects of the Work that EPA does not elect to perform. The election by EPA to perform all or part of the Work under this Order does not relieve Respondents from any past or future violations of this or any other Order. EPA also expressly reserves all its rights to seek appropriate relief, including but not limited to penalties, damages and injunctive relief.

XV. PROGRESS REPORTS

81. In addition to the other deliverables set forth in this Order and prior orders and order amendments, Respondents shall provide monthly progress reports to EPA with respect to actions and activities undertaken pursuant to this Order. The progress

reports shall be submitted on or before the 21st day of each month following the effective date of this Order. Respondents' obligation to submit progress reports continues until EPA gives Respondents written notice that such progress reports are no longer necessary. At a minimum these progress reports shall: (1) describe the actions which have been taken to comply with this Order during the prior month; (2) include all results of sampling and tests and all other data received by Respondents and not previously submitted to EPA; (3) describe all work planned for the next month with schedules relating such work to the overall project schedule for RD/RA completion; and (4) describe all problems encountered and any anticipated problems, any actual or anticipated delays, and solutions developed and implemented to address any actual or anticipated problems or delays.

XVI. QUALITY ASSURANCE, SAMPLING AND DATA ANALYSIS

82. Respondents shall use the quality assurance, quality control, and chain of custody procedures described in the "EPA NEIC Policies and Procedures Manual," May 1978, revised May 1986, EPA-330/9-78-001-R, EPA's "Guidelines and Specifications for Preparing Quality Assurance Program Documentation," June 1, 1987, EPA's "Data Quality Objective Guidance," (EPA/540/G87/003 and 004) and any amendments to these documents, while conducting all sample collection and analysis activities required herein by any plan. To provide quality assurance and maintain quality control, Respondents shall:

a. Use only laboratories which have a documented Quality Assurance Program that complies with EPA guidance document QAMS-005/80;

b. Ensure that the laboratory used by the Respondents for analyses, performs according to a method or methods deemed satisfactory to EPA and submits all protocols to be used for analyses to EPA at least 14 days before beginning analysis; and

c. Ensure that EPA personnel and EPA's authorized representatives are allowed access to the laboratory and personnel utilized by the Respondents for analyses.

83. If Respondents determine that it is necessary or appropriate to conduct any sample collection or Site investigation activity, not otherwise specified in the Statement of Work or PDA, Respondents shall notify EPA not less than fourteen (14) days in advance of such sample collection or Site investigation activity. At the request of EPA, Respondents shall allow split or duplicate samples to be taken by EPA or its authorized representatives, of any samples collected by Respondents with regard to the Site or pursuant to the implementation of this Order. In addition, EPA shall have the right to take any additional samples that EPA deems necessary.

XVII. COMPLIANCE WITH APPLICABLE LAWS

84. All activities by Respondents pursuant to this Order shall be performed in accordance with the requirements of all Federal and state laws and regulations. EPA has determined that the activities contemplated by this Order are consistent with the National Contingency Plan ("NCP").

85. Except as provided in section 121(e) of CERCLA and the NCP, no permit shall be required for any portion of the Work conducted entirely on-Site. Where any portion of the Work requires a Federal or state permit or approval, Respondents shall submit timely applications and take all other actions necessary to obtain and to comply with all such permits or approvals.

86. This Order is not, and shall not be construed to be, a permit issued pursuant to any Federal or state statute or regulation.

87. All materials removed from the Site shall be disposed of or treated at a facility approved by EPA's RPM and in accordance with section 121(d)(3) of CERCLA, 42 U.S.C. § 9621(d)(3); with the U.S. EPA "Revised Off-Site Policy," OSWER Directive 9834.11, November 13, 1987; and with all other applicable Federal, state, and local requirements.

XVIII. REMEDIAL PROJECT MANAGER

88. All communications, whether written or oral, from Respondents to EPA shall be directed to EPA's Remedial Project Manager or Alternate Remedial Project Manager. Respondents shall submit to EPA three copies of all documents, including plans, reports, and other correspondence, which are developed pursuant to this Order, and shall send these documents by certified mail or overnight mail.

EPA's Remedial Project Manager:

Rick Sugarek
United States Environmental Protection Agency
Region 9
75 Hawthorne Street SFD-7-2
San Francisco, California 94105
(415) 744-2226

EPA's Alternate Remedial Project Manager is:

Kathi Moore
United States Environmental Protection Agency
Region 9
75 Hawthorne Street SFD-7-2
San Francisco, California 94105
(415) 744-2221

89. EPA has the unreviewable right to change its RPM and Alternate RPM. If EPA changes its RPM or Alternate RPM, EPA will inform Respondents in writing of the name, address, and telephone number of the new RPM (or alternate).

90. EPA's RPM and Alternate RPM shall have the authority lawfully vested in a Remedial Project Manager ("RPM") and On-Scene Coordinator ("OSC") by the National Contingency Plan, 40 C.F.R. Part 300. EPA's RPM shall have authority, consistent with the National Contingency Plan, to halt any work required by this Order, and to take any necessary response action.

91. Within ten (10) days after the effective date of this Order, Respondents shall designate a Project Coordinator and shall submit the name, address, and telephone number of the Project Coordinator to EPA for review and approval. Respondents' Project

Coordinator shall be responsible for overseeing Respondents' implementation of this Order. If Respondents wish to change their Project Coordinator, Respondents shall provide written notice to EPA, five (5) days prior to changing the Project Coordinator, of the name and qualifications of the new Project Coordinator. Respondents selection of a Project Coordinator shall be subject to EPA approval.

XIX. SITE ACCESS AND DATA/DOCUMENT AVAILABILITY

92. Respondents shall allow EPA and its authorized representatives and contractors to enter and freely move about all property at the Site and off-Site areas subject to or affected by the work under this Order or where documents required to be prepared or maintained by this Order are located, for the purposes of inspecting conditions, activities, the results of activities, records, operating logs, and contracts related to the Site or Respondents and its representatives or contractors pursuant to this Order; reviewing the progress of the Respondents in carrying out the terms of this Order; conducting tests as EPA or its authorized representatives or contractors deem necessary; using a camera, sound recording device or other documentary type equipment; and verifying the data submitted to EPA by Respondents. Respondents shall allow EPA and its authorized representatives to enter the Site and any off-site areas, to inspect and copy all records, files, photographs, documents, sampling and monitoring data, and other writings related to work undertaken in carrying out this Order. Nothing herein shall be interpreted as limiting or affecting EPA's right of entry or inspection authority under Federal law.

93. Respondents shall permit EPA and EPA representatives to monitor plant operations, plant performance or other response actions, in whatever manner EPA and its representatives deem appropriate. This paragraph does not supersede or affect any rights of inspection or other rights that EPA has under this Order or any other order or any other statutory authority. Upon

oral request by EPA or an EPA representative, Respondents shall provide immediate access to AMD flow data, and all other analytical data that is currently available, in hard copy and electronic format. In conducing its monitoring activities, EPA and its representatives will endeavor to minimize interference with Respondents' operation and maintenance of the treatment plant and other response actions.

94. Within 48 hours of receiving a written request for such information from EPA (or such other time as specified in the EPA request), Respondents shall provide to EPA, and to such other persons as EPA identifies, available flow data, water quality data and other requested information that may be available.

95. Unless otherwise specified by EPA, Respondents shall provide all data submittals (in the monthly report and otherwise), and other deliverables at EPA's request, in hard copy and electronic format.

96. Respondents may assert a claim of business confidentiality covering part or all of the information submitted to EPA pursuant to the terms of this Order under 40 C.F.R. § 2.203, provided such claim is not inconsistent with section 104(e)(7) of CERCLA, 42 U.S.C. § 9604(e)(7) or other provisions of law. This claim shall be asserted in the manner described by 40 C.F.R. § 2.203(b) and substantiated by Respondents at the time the claim is made. Information determined to be confidential by EPA will be given the protection specified in 40 C.F.R. Part 2. If no such claim accompanies the information when it is submitted to EPA, it may be made available to the public by EPA or the state without further notice to the Respondents. Respondents shall not assert confidentiality claims with respect to any data related to Site conditions, sampling, or monitoring.

97. For the period during which this Order is in effect, Respondents shall maintain an index of documents that Respondents claim contain confidential business information. The index shall contain, for each document, the date, author, addressee, and subject of the document. Upon written request from EPA,

Respondents shall submit a copy of the index to EPA.

XX. RECORD PRESERVATION

98. Respondents shall provide to EPA upon request, copies of all documents and information within their possession and/or control or that of their contractors or agents relating to activities at the Site or to the implementation of this Order, including but not limited to sampling, analysis, chain of custody records, manifests, trucking logs, receipts, reports, sample traffic routing, correspondence, or other documents or information related to the Work. Respondents shall also make available to EPA for purposes of investigation, information gathering, or testimony, their employees, agents, or representatives with knowledge of relevant facts concerning the performance of the Work.

99. Until ten (10) years after EPA provides notice pursuant to paragraph 61, each Respondent shall preserve and retain all records and documents in its possession or control, including the documents in the possession or control of their contractors and agents on and after the effective date of this Order that relate in any manner to the Site. At the conclusion of this document retention period, Respondents shall notify the United States at least ninety (90) calendar days prior to the destruction of any such records or documents, and upon request by the United States, Respondents shall deliver any such records or documents to EPA.

100. Until ten (10) years after EPA provides notice pursuant to paragraph 51 of this Order, Respondents shall preserve, and shall instruct their contractors and agents to preserve, all documents, records, and information of whatever kind, nature or description relating to the performance of the Work. Upon the conclusion of this document retention period, Respondents shall notify the United States at least ninety (90) days prior to the destruction of any such records, documents or information, and, upon request of the United States, Respondents shall deliver all such documents, records and information to EPA.

101. Within 30 days after the effective date of this Order, Respondents shall submit a written certification to EPA's RPM that they have not altered, mutilated, discarded, destroyed or otherwise disposed of any records, documents or other information relating to their potential liability with regard to the Site since notification of potential liability by the United States or the State or the filing of suit against them regarding the Site. Respondents shall not dispose of any such documents without prior approval by EPA. Respondents shall, upon EPA's request and at no cost to EPA, deliver the documents or copies of the documents to EPA.

XXI. DELAY IN PERFORMANCE

102. Any delay in performance of this Order that, in EPA's judgment, is not properly justified by Respondents under the terms of this paragraph shall be considered a violation of this Order. Any delay in performance of this Order shall not affect Respondents obligations to fully perform all obligations under the terms and conditions of this Order.

103. Respondents shall notify EPA of any delay or anticipated delay in performing any requirement of this Order. Such notification shall be made by telephone to EPA's RPM within forty-eight (48) hours after Respondents first knew or should have known that a delay might occur. Respondents shall adopt all reasonable measures to avoid or minimize any such delay. Within five (5) business days after notifying EPA by telephone, Respondents shall provide written notification fully describing the nature of the delay, any justification for delay, any reason why Respondents should not be held strictly accountable for failing to comply with any relevant requirements of this Order, the measures planned and taken to minimize the delay, and a schedule for implementing the measures that will be taken to mitigate the effect of the delay. Increased costs or expenses associated with implementation of the activities called for in this Order is not a justification for any delay in performance.

XXII. ASSURANCE OF ABILITY TO COMPLETE WORK

104. Within 30 days of receipt of a written request for financial assurance from EPA, Respondents shall demonstrate their ability to complete the Work required by this Order and to pay all claims that arise from the performance of the Work by obtaining and presenting to EPA one of the following: (1) a performance bond; (2) a letter of credit; (3) a guarantee by a third party; or (4) internal financial information to allow EPA to determine that Respondent(s) has (have) sufficient assets available to perform the Work. Respondents shall demonstrate financial assurance in an amount no less than the estimate of cost for the activities required by the Statement of Work. If Respondents seeks to demonstrate ability to complete the remedial action by means of internal financial information, or by guarantee of a third party, they shall re-submit such information annually, on the anniversary of the effective date of this Order. If EPA determines that such financial information is inadequate, Respondents shall, within thirty (30) days after receipt of EPA's notice of determination, obtain and present to EPA for approval one of the other three forms of financial assurance listed above.

105. At least seven (7) days prior to commencing any work at the Site pursuant to this Order, Respondents shall submit to EPA a certification that Respondents or their contractors and subcontractors have adequate insurance coverage or have indemnification for liabilities for injuries or damages to persons or property which may result from the activities to be conducted by or on behalf of Respondents pursuant to this Order. Respondents shall ensure that such insurance or indemnification is maintained for the duration of the Work required by this Order.

XXIII. REIMBURSEMENT OF RESPONSE COSTS

106. Respondents shall reimburse EPA, upon written demand, for all response costs incurred by the United States in overseeing Respondents' implementation of the requirements of this Order or in performing any response action which Respondents fails to

perform in compliance with this Order. EPA may submit to Respondents on a periodic basis an accounting of all response costs incurred by the United States with respect to this Order. EPA's certified Agency Financial Management System summary data ("SPUR Reports"), or such other summary as certified by EPA, shall serve as basis for payment demands.

107. Respondents shall, within thirty (30) days of receipt of each EPA accounting, remit a certified or cashier's check for the amount of those costs. Interest shall accrue from the later of the date that payment of a specified amount is demanded in writing or the date of the expenditure. The interest rate is the rate established by the Department of the Treasury pursuant to 31 U.S.C. § 3717 and 4 C.F.R. § 102.13.

108. Checks shall be made payable to the Hazardous Substances Superfund and shall include the name of the Site, the Site identification number, the account number and the title of this Order. Checks shall be forwarded to:

U.S. Environmental Protection Agency
Superfund Accounting
P.O. Box 360863M
Pittsburgh, PA 15251

109. Respondents shall send copies of each transmittal letter and check to the EPA's RPM.

XXIV. UNITED STATES NOT LIABLE

110. The United States, by issuance of this Order, assumes no liability for any injuries or damages to persons or property resulting from acts or omissions by Respondent(s), or its (their) directors, officers, employees, agents, representatives, successors, assigns, contractors, or consultants in carrying out any action or activity pursuant to this Order. Neither EPA nor the United States may be deemed to be a party to any contract entered into by Respondents or its (their) directors, officers, employees, agents, successors, assigns, contractors, or consultants in carrying out any action or activity pursuant to this Order.

XXV. ENFORCEMENT AND RESERVATIONS

111. EPA reserves the right to bring an action against Respondents under section 107 of CERCLA, 42 U.S.C. § 9607, for recovery of any response costs incurred by the United States related to this Order and not reimbursed by Respondents. This reservation shall include but not be limited to past costs, direct costs, indirect costs, the costs of oversight, the costs of compiling the cost documentation to support oversight cost demand, as well as accrued interest as provided in section 107(a) of CERCLA.

112. Notwithstanding any other provision of this Order, at any time during the response action, EPA may perform its own studies, complete the response action (or any portion of the response action) as provided in CERCLA and the NCP, and seek reimbursement from Respondents for its costs, or seek any other appropriate relief.

113. Nothing in this Order shall preclude EPA from taking any additional enforcement actions, including modification of this Order or issuance of additional Orders, and/or additional remedial or removal actions as EPA may deem necessary, or from requiring Respondents in the future to perform additional activities pursuant to CERCLA, 42 U.S.C. § 9606(a), et seq., or any other applicable law. Respondents shall be liable under CERCLA section 107(a), 42 U.S.C. § 9607(a), for the costs of any such additional actions.

114. Notwithstanding any provision of this Order, the United States hereby retains all of its information gathering, inspection and enforcement authorities and rights under CERCLA, RCRA and any other applicable statutes or regulations.

115. Respondents shall be subject to civil penalties under section 106(b) of CERCLA, 42 U.S.C. § 9606(b), of not more than $25,000 for each day in which Respondents willfully violates, or fails or refuses to comply with this Order without sufficient cause. In addition, failure to properly provide response action under this Order, or any portion hereof, without sufficient

cause, may result in liability under section 107(c)(3) of CERCLA, 42 U.S.C. § 9607(c)(3), for punitive damages in an amount at least equal to, and not more than three times the amount of any costs incurred by the Fund as a result of such failure to take proper action.

116. Nothing in this Order shall constitute or be construed as a release from any claim, cause of action or demand in law or equity against any person for any liability they may have arising out of or relating in any way to the Site.

117. If a court issues an order that invalidates any provision of this Order or finds that Respondents has sufficient cause not to comply with one or more provisions of this Order, Respondents shall remain bound to comply with all provisions of this Order not invalidated by the court's order.

XXVI. ADMINISTRATIVE RECORD

118. Upon request by EPA, Respondents must submit to EPA all documents related to the selection or implementation of a response action for possible inclusion in the administrative record file.

XXVII. EFFECTIVE DATE AND COMPUTATION OF TIME

119. This Order shall be effective 20 days after the Order is signed by the Director, Superfund Division. Unless otherwise specified, all times for performance of ordered activities shall be calculated from this effective date.

XXVIII. OPPORTUNITY TO CONFER

120. Respondents may, within ten (10) days after the date this Order is signed, request a conference with EPA's Director, Hazardous Waste Management Division, to discuss this Order. If requested, the conference shall occur no later than ten (10) days after the request is made and shall be held at EPA Region 9, 75 Hawthorne Street, San Francisco, California. The Director may designate an alternate to meet with Respondents in the event of a

schedule conflict.

121. The purpose and scope of the conference shall be limited to issues involving the implementation of the response actions required by this Order and the extent to which Respondents intends to comply with this Order. This conference is not an evidentiary hearing, and does not constitute a proceeding to challenge this Order. It does not give Respondents a right to seek review of this Order, or to seek resolution of potential liability, and no official stenographic record of the conference will be made. At any conference held pursuant to Respondents' request, Respondents may appear in person or by an attorney or other representative.

122. Requests for a conference must be by telephone followed by written confirmation mailed that day to:

Rick Sugarek
United States Environmental Protection Agency
Region 9
75 Hawthorne Street
San Francisco, California 94105
(415) 744-2226

XXIX. EFFECT ON PREVIOUS ORDERS

123. Nothing in this Order shall be construed to excuse any non-compliance with any previous order issued to Respondents, including Order Nos. 89-18, 90-08, 91-18, 92-26, 93-01 and 94-12 and all amendments thereof.

124. Except as expressly provided herein, nothing in this Order shall be construed as amending any previous order issued to Respondents.

So Ordered, this __ day of September, 1997.

BY: _____
Keith A. Takata
Director, Superfund Division
U.S. Environmental Protection Agency, Region 9

TABLE OF CONTENTS

ATTACHMENT "A"

RECORD OF DECISION
IRON MOUNTAIN MINE
SHASTA COUNTY, CALIFORNIA

THE DECLARATION

I. SITE NAME AND LOCATION

Iron Mountain Mine (IMM)
Shasta County, California (approximately 9 miles northwest of Redding, California)

II. STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected interim remedial action for control of releases of hazardous substances from widespread area sources in the Slickrock Creek watershed at the Iron Mountain Mine Site. The selected interim remedial action was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based upon the Administrative Record for this Site.

The State of California concurs with the selected interim remedial action for the Slickrock Creek area source acid mine drainage (AMD) discharges at the Iron Mountain Mine Superfund Site.

III. ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

The Slickrock Creek area sources of AMD include the numerous waste piles on the mine property, disturbed areas related to mining activity, contaminated groundwater and interflow seepage, underground mine workings, and underground mineralization exposed through mining-induced hydrologic and physical changes. The general disturbances in this area of Slickrock Creek are shown in Photo Exhibit 1. The releases from these sources consist of highly acidic, heavy metal-bearing waters, termed acid mine drainage, or AMD. The heavy metals contained in the AMD from Slickrock Creek area sources include, among others, copper, cadmium, and zinc. The AMD contains acidity and concentrations of copper, cadmium, and zinc that are toxic to aquatic life and harmful to humans. The response action will also address the hematite mine waste piles, which contain high levels of arsenic and are actively eroding into Slickrock Creek and thence to downstream areas.

The principal threat posed by these releases is the creation of conditions toxic to aquatic life in the receiving waters downstream of the Site. Surface water is the primary exposure path-

way for discharges from the Slickrock Creek sources. The surface waters in the Spring Creek drainage affected by the Slickrock Creek area sources (Slickrock Creek, Spring Creek, and the Spring Creek Reservoir [SCR]) are essentially devoid of aquatic life as a result of releases of hazardous substances from the Site.

The SCR meters contaminated IMM AMD into the Sacramento River at Keswick Reservoir. The SCR, coupled with the prior CERCLA response actions implemented pursuant to the 1986 (ROD1) , 1992 (ROD2), and 1993 Records of Decision (ROD3), provides some degree of protection to aquatic resources and public health below the SCR, but IMM AMD discharges continue to harm and pose risks to aquatic resources in Keswick Reservoir and the Sacramento River (particularly during certain storm events when discharges from the Site are greatest), and to a significantly lesser degree, to public health. These discharges also fail to comply with CERCLA requirements. Even taking into account the response actions implemented to date (which have reduced sitewide releases by approximately 80 to 90 percent on average over the past several years), IMM AMD is expected to cause regular annual exceedances of protective water quality standards in Keswick Reservoir, continued exceedances in the Sacramento River under certain storm conditions, and the continued release of 25,000 to 70,000 pounds per year of copper and 40,000 to 90,000 pounds of zinc to Keswick Reservoir and the main stem of the Sacramento River in normal to wet water years. These discharges are approximately one to three times the metal load of all industrial discharges in the Sacramento River, Bay, and Delta combined.

Just below the point at which IMM AMD enters the Sacramento River, the Sacramento River supports a valuable fishery that includes four species of chinook salmon, steelhead, and resident trout. The winter-run chinook salmon has been designated as an endangered species under the federal Endangered Species Act, and at least one other species (the Sacramento River steelhead) is currently being considered for listing as endangered under that statute. The spring-run chinook salmon is currently a candidate species under the State Endangered Species Act. These species are particularly sensitive to toxic metals such as copper, cadmium, and zinc. The National Oceanic and Atmospheric Administration (NOAA) has identified the affected area as the most important salmon habitat in California.

Releases of hazardous substances from the site also pose a potential threat to human health. Concentrated AMD is harmful to humans. There is also a human health risk associated with consumption of fish contaminated by heavy metals from the site. The Sacramento River which receives releases of hazardous substances from the site serves as a source of drinking water for the City of Redding, although exceedances of drinking water criteria for metals and acidity due to site releases is expected to be rare. In addition, releases of arsenic from mine waste piles poses a potential threat to humans.

Through the performance of continuing remedial investigations and feasibility studies, the U.S. Environmental Protection Agency (EPA) has identified the control of the IMM area source AMD discharges from the Slickrock Creek and Boulder Creek watersheds as being necessary to meet remedial action objectives for the Site. Actual or threatened releases of AMD from both of these watersheds, if not addressed by implementing appropriate response actions, may present an imminent and substantial endangerment to human health or the environment. The response action selected in this Record of Decision (ROD4), however,

only addresses the Slickrock Creek area source AMD discharges (which are estimated to account for approximately 60 to 70 percent of the copper load and 40 to 50 percent of the zinc and cadmium load associated with the currently uncontrolled Site discharges). The selected response action for the Slickrock Creek area source AMD discharges is expected to make significant progress toward abating the imminent and substantial endangerment to human health and the environment caused by the continuing AMD discharges from the IMM area sources. The EPA has determined that further study is warranted to support continued development and evaluation of remedial alternatives for the Boulder Creek area source AMD discharges. The EPA anticipates that an additional remedial investigation and feasibility study will be conducted to develop and evaluate control strategies for the area sources in Boulder Creek. The EPA also anticipates investigating the need to respond to other sources of mining-related hazardous substance releases from IMM, including but not limited to sediments deposited by past and current AMD releases.

IV. DESCRIPTION OF PRIOR REMEDIAL ACTIONS

The first ROD for the IMM Site (ROD1), signed in October 1986, provided for implementation of limited source control actions to begin lessening the IMM AMD discharges and also provided water management capability to manage the ongoing IMM AMD releases to surface waters. Specific activities authorized by ROD1 include a diversion of Slickrock Creek around contaminant-bearing landslide debris, diversion of Upper Spring Creek to the Flat Creek drainage, and a partial cap of Brick Flat Pit and seven subsidence areas. All of these projects have been completed. ROD1 also authorized the enlargement of the Spring Creek Debris Dam (SCDD) and the diversion of the South Fork of Spring Creek (SFSC). These two water management projects were deferred by EPA to allow for additional evaluation.

Pursuant to Records of Decision signed by EPA in 1992 (ROD2) and 1993 (ROD3), essentially all AMD releases from the three largest sources of IMM AMD (the Richmond portal, the Lawson portal, and the Old/No. 8 Mine Seep) are treated at the IMM treatment plant. The EPA selected the high density sludge (HDS) treatment process to ensure the long-term reliability, effectiveness, and cost-effectiveness of IMM treatment and sludge disposal operations. The treatment residuals are disposed of onsite in the inactive open pit mine, Brick Flat Pit. The response actions implemented pursuant to these two RODs have significantly reduced the release of hazardous substances from the Site. For example, during the period from January 1995 through March 1995, treatment of the IMM AMD from these three underground mine workings reduced sitewide discharges of copper, zinc, and cadmium by approximately 80 to 90 percent.

V. EPA's JUNE 1994 PROPOSED PLAN

In a Proposed Plan issued in June 1994, EPA proposed to enlarge the SCDD to establish a 15,000-acre-foot reservoir and to defer implementation of the SFSC diversion. Enlargement of the SCDD and construction of the SFSC were both components of the 1986 ROD. The 1986 ROD had deferred sizing of the reservoir. At the of the June 1994 Proposed Plan, it was EPA's assessment that source control and treatment alternatives were not available that could provide sufficient control of the IMM area source AMD discharges to meet remedial action objectives for the Site. The EPA had determined that the proposed enlargement of the

SCDD would provide sufficient water management capability to meet certain remedial action objectives for the Site, considering the extent of technical practicability limitations. The EPA received comments during the public comment period that identified additional source control and treatment alternatives for the IMM area source AMD discharges. The comments supported the technical feasibility of the source control and treatment approaches. Commenters also stated a preference for source control and treatment approaches over water management remedial alternatives. Taking into account these comments, the EPA deferred remedy selection and performed further studies of the suggested source control and treatment alternatives.

VI. DESCRIPTION OF THE SELECTED REMEDY

The selected interim remedial action is the fourth ROD for the IMM Superfund cleanup action. It focuses on the Slickrock Creek area source AMD discharges. The selected remedy, which is the same remedy EPA proposed in its May 1996 Proposed Plan, was largely derived from an alternative developed by a potentially responsible party and submitted to EPA during the public comment period on the 1994 Proposed Plan. The selected remedy addresses the principal threat posed by contaminant releases from area sources within the Slickrock Creek watershed at the IMM Site through collection, conveyance, and treatment of all of the flows in the most contaminated reach of Slickrock Creek, located directly downstream of the most heavily disturbed mining area in the basin. The selected remedy will involve constructing a dam to establish a small reservoir in Slickrock Creek to collect and contain the contaminated runoff for controlled conveyance to an expanded IMM HDS treatment plant. The selected remedy also involves constructing a surface water diversion to keep relatively uncontaminated surface water from flowing into the reservoir. The diversion will minimize the amount of water that requires treatment and the size of the dam required to ensure adequate storage capacity of the containment reservoir. New and modified pipelines will convey the contaminated water from the reservoir to the treatment plant. Necessary modifications to the IMM HDS treatment plant will be constructed. A conceptual depiction of the remedy is shown in Photo Exhibit 2.

The major components of the selected remedy include:

- Construct a retention dam and necessary surface water diversion facilities to ensure the collection and storage of contaminated surface runoff, interflow, and groundwater in the Slickrock Creek watershed at IMM.

- Construct facilities to provide controlled release of contaminated waters from the retention dam to the AMD conveyance pipeline to the IMM HDS/ASM lime neutralization treatment plant.

- Construct facilities to divert relatively uncontaminated surface water from the area upstream from the highly disturbed mining area of the Slickrock Creek basin and divert that water around the Slickrock Creek retention reservoir. The diversion shall also divert around the retention reservoir the water from the unmined side of the Slickrock Creek watershed.

- Take appropriate steps (including consideration of emergency failure scenarios) to integrate into the operation of the reservoir the collection and conveyance of the Old/No. 8 Mine Seep AMD to the IMM HDS/ASM lime neutralization treatment plant.

- Construct a hematite erosion control structure consistent with California mining waste requirements.

- Construct one or more sedimentation basin(s) or other EPA approved control structures in the Slickrock Creek watershed to minimize sedimentation of the Slickrock Creek retention reservoir and to ensure proper functioning of the controlled release facilities.

- Upgrade the hydraulic capacity of the existing pipeline (or if necessary construct a new pipeline) from Slickrock Creek to the Boulder Creek crossing as required to ensure adequate reliable capacity to convey Slickrock Creek and Old/No. 8 Mine Seep AMD.

- Construct an additional pipeline to reliably convey Slickrock Creek and Old/No. 8 Mine Seep AMD from the Boulder Creek Crossing to the IMM HDS/ASM lime neutralization treatment plant.

- Modify the IMM HDS/ASM lime neutralization treatment plant to ensure proper treatment, using the HDS/ASM treatment process, of the Slickrock Creek area source AMD discharges in conjunction with AMD flows collected pursuant to other Records of Decision.

- Construct a tunnel to provide for gravity discharge of the high volumes of effluent from the IMM HDS/ASM treatment plant to Spring Creek below the Upper Spring Creek diversion to Flat Creek.

- Construct facilities to assure collection of significant identified sources (including but not limited to seeps from Brick Flat Pit and the hematite piles) and convey those releases to the Slickrock Creek Retention Reservoir.

- Perform long-term operations and maintenance (O&M) of all components.

VII. STATUTORY DETERMINATIONS

Protective of Human Health and the Environment

With respect to the releases of hazardous substances that will be addressed by this interim action, this selected interim remedy is protective of human health and the environment. The selected interim remedy essentially eliminates the potential exposure and the resultant threats to human health and the environment from the Slickrock Creek area sources and the AMD discharge pathways addressed in this interim remedy. While the interim remedy is expected to essentially eliminate the risk posed by certain releases of hazardous substances from the facility, the interim remedy responds to only a subset of the currently uncontrolled releases of hazardous substances being released from the facility. The EPA therefore anticipates that the

remedy will not fully protect human health and the environment and that additional remedial action will be required to respond to releases of hazardous substances from the facility.

Compliance with ARARs

Except for those applicable or relevant and appropriate requirements (ARARs) that EPA is waiving for this interim remedy, the interim remedy will comply with all Federal and State ARARs.

The EPA is waiving compliance with certain ARARs on the basis that this proposed action is an interim action that will not respond to all releases of hazardous substances from the facility. This interim action is not expected to provide for compliance with all ARARs at all times because the dam and treat interim remedial action for the Slickrock Creek area source AMD discharges does not address releases other than area sources in the Slickrock Creek watershed above the containment structure to be constructed on Slickrock Creek, such as releases from area sources in the Boulder Creek watershed, the existing sediments in SCR and Keswick Reservoir, and the streambeds in the Spring Creek watershed.

Since the action selected in this ROD is an interim action that leaves some releases of hazardous substances unabated, EPA is relying on the ARARs waiver for "interim measures" (CERCLA § 121(d)(4)(A); 40 CFR § 300.430(f)(1)(ii)(C)(1)) for this remedial action. In particular, EPA anticipates that the remedy will improve water quality in Spring Creek, SCR, Keswick Reservoir, and the Sacramento River, but EPA does not anticipate that this remedy, in conjunction the other remedies implemented to date, will be sufficient to ensure compliance with (1) the numeric, chemical-specific standards contained in the State Basin Plan Standards (SBPS) for copper, cadmium, or zinc, and (2) California Fish and Game Code § 5650 (which prohibits discharge of contaminants "deleterious to fish, plant life, or bird life"). The EPA is therefore waiving compliance with those standards for the interim action to the extent those standards cannot be achieved by the remedy selected in this ROD in conjunction with the remedies implemented under prior RODs. The EPA anticipates that completion of additional remedial actions will address compliance with these ARARs.

Cost-Effectiveness

The EPA has determined that the selected remedy is cost-effective pursuant to evaluations in accordance with § 300.430(f)(1)(ii)(D) of the NCP.

Permanent Solutions and Treatment Technologies

The EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized for the remedial action for the Slickrock Creek area source AMD discharges. This proposed remedy involves as its principal element the treatment of hazardous substance releases from the Slickrock Creek area sources upstream of the retention dam.

The remedy will not reduce the generation of hazardous substances in the same manner that a remedy that reduces or eliminates AMD-forming reactions (and thereby reduce the need for ongoing treatment operations). The EPA has concluded that source-specific control actions may be available for at least some of the Slickrock Creek area source AMD discharges. However, those control actions are not currently implementable, effective, or cost-effective in

comparison to the selected dam and treat remedial action. While current technology and knowledge are not sufficient to permit implementation of reliable source-specific controls for the Slickrock Creek area sources, EPA encourages the continued development of those alternatives that could reduce or eliminate the AMD-forming reactions. The EPA will continue to consider subsequent action for the IMM Site that could supplant the need to perform long-term treatment of the area source AMD discharges.

Consistency with Final Remedy

This action of selecting a remedial alternative that addresses Slickrock Creek without first requiring completion of the studies for Boulder Creek is consistent with 40 CFR § 300.430 (a)(ii)(A), which identifies as a program management principle that "[s]ites should generally be remediated in operable units when necessary or appropriate to achieve significant risk reduction quickly, when phased analysis and response is necessary or appropriate given the size and complexity of the Site, or to expedite the completion of total Site cleanup." The investigations conducted by the EPA to date, including an intensive peer review of control options, indicate that technically practicable and cost-effective remedies are available to remediate releases of hazardous substances from Boulder Creek area sources and from sediments in and below SCR.

This action does not constitute the final remedy for the IMM Site. Additional response actions will further address the statutory preference for remedies employing treatment that reduces toxicity, mobility, or volume as a principal element. Subsequent actions are planned to fully address the threats posed by the conditions at the facility. This remedy will result in hazardous substances remaining onsite above health-based levels, so within 5 years after commencement of the remedial action, EPA will conduct a review to ensure that the remedy continues to provide adequate protection of human health and the environment. This is an interim action ROD, so review of this facility and of this remedy will be ongoing as EPA continues to develop final remedial alternatives for the Site.

Keith A. Takata — 9-30-97

Keith A. Takata, Director — Date
Superfund Division
U.S. Environmental Protection Agency

RECORD OF DECISION
IRON MOUNTAIN MINE
SHASTA COUNTY, CALIFORNIA

THE DECISION SUMMARY

I. SITE NAME, LOCATION, AND DESCRIPTION

I.1 Site Name

Iron Mountain is located in Shasta County, California, approximately 9 miles northwest of the City of Redding (Figure 1). The collection of mines on Iron Mountain is known as Iron Mountain Mines. The Iron Mountain Mines are the southernmost mines in the West Shasta Mining District. The District encompasses more than a dozen sulfide mines that have been worked for silver, gold, copper, zinc, and pyrite.

I.2 Site Location

The Iron Mountain Mine (IMM) Superfund Site is defined pursuant to CERCLA to include the inactive mines on Iron Mountain and areas where hazardous substances released from the mines are now located. The IMM Site contains approximately 4,400 acres of land that includes the mining property on Iron Mountain; the several inactive underground and open pit mines; numerous waste piles; abandoned mining facilities; mine drainage treatment facilities; the downstream reaches of Boulder Creek, Slickrock Creek, Flat Creek, and Spring Creek; Spring Creek Reservoir (SCR); Keswick Reservoir (which includes both the Spring Creek arm of the Keswick Reservoir and the main body of Keswick Reservoir); and the Sacramento River affected by drainage from IMM.

I.3 Site Description

The summit of Iron Mountain is 3,583 feet above mean sea level and is approximately 3,000 feet above the Sacramento River, 3 miles to the east. The terrain is very steep, with slopes dropping 1 to 2 feet for every 2 feet horizontally, or steeper. The mountain is predominantly forested with areas of brush, and there are numerous unpaved roads leading to the various work locations.

Several, and possibly all, of the mines and the waste rock piles are discharging acidic waters, typically with a high content of heavy metals. These discharges are herein referred to collectively as acid mine drainage, or AMD. The largest sources of AMD are located within the IMM property. The largest source of AMD is the Richmond Mine, and the second largest is the Hornet Mine. Both of these sources drain into Boulder Creek. The third largest source, Old/No. 8 Mine Seep, drains into Slickrock Creek. From 1988 to 1994 a portion of these sources were treated at an emergency treatment plant. Starting in 1994, essentially all of

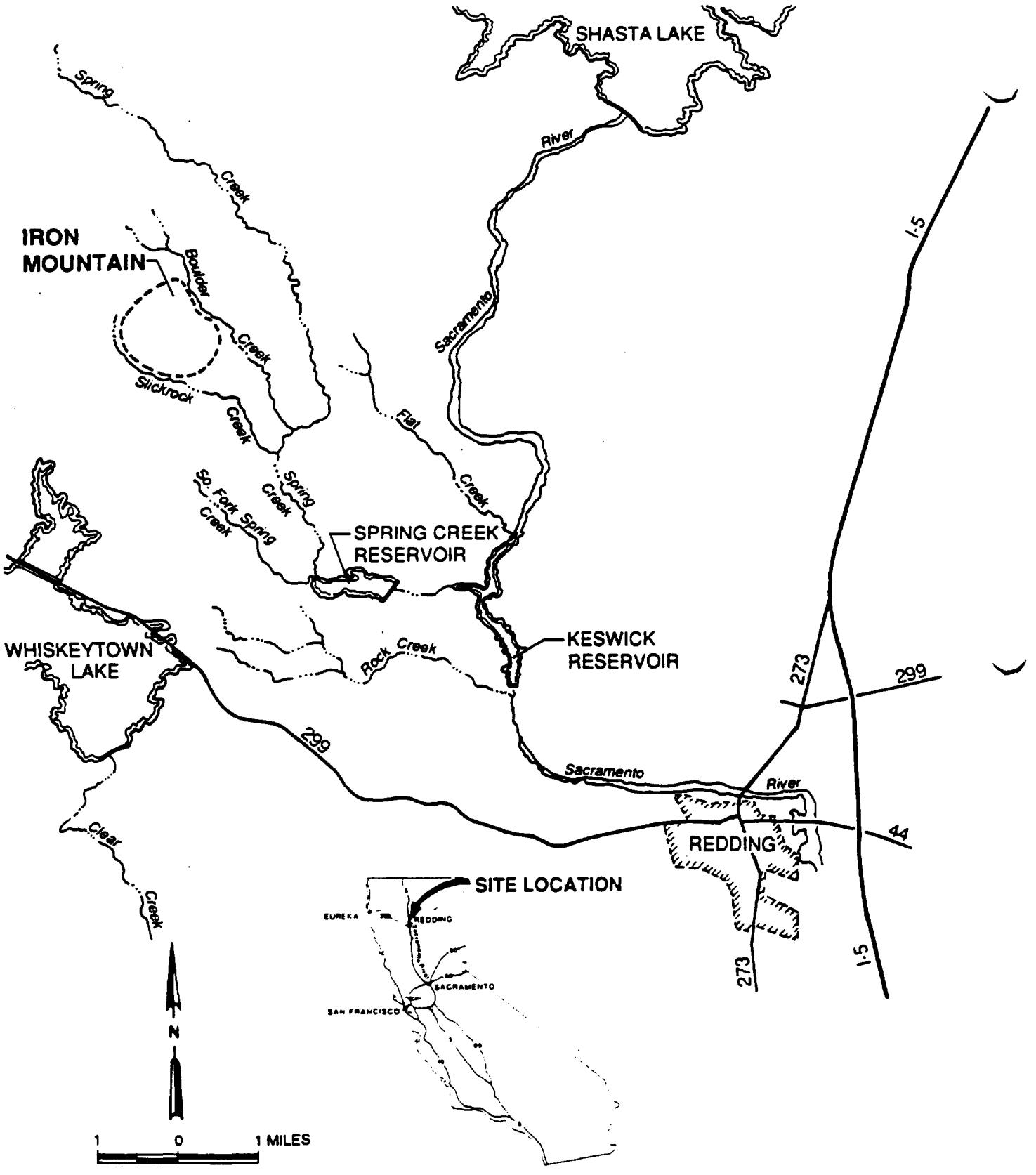


FIGURE 1
LOCATION OF
IRON MOUNTAIN SITE
IRON MOUNTAIN MINE

these sources have been treated at the IMM treatment plant constructed onsite at Minnesota Flats. From 1994 to 1996 the AMD was treated using the simple mix treatment method. Since January 1997, the HDS treatment system has provided an improved means of treating these discharges.

These remedies have been highly effective in reducing the release of metals from the site. Over the past several years, the treatment of selected AMD flows from IMM has reduced the release of copper, cadmium, and zinc by approximately 80 to 90 percent.

The remaining discharges derive from widely dispersed area sources associated with past mining activities. The IMM area sources include waste piles; sidecast spoils; ground disturbed by mining-related activities; mineralization exposed by mining-induced water table depressions and other hydraulic changes induced by mining; discharges from buried workings or partially accessible workings; contaminated soil and debris; mining-caused seeps; contaminated interflow and groundwater; and contaminated sediments in the Slickrock Creek, Boulder Creek, and Spring Creek watersheds at IMM. This ROD addresses area sources in the Slickrock Creek watershed, which account for approximately 60 to 70 percent of the uncontrolled copper loads, and 40 to 50 percent of the uncontrolled zinc and cadmium loads currently being generated at IMM. The discharges from these sources are closely associated with heavy rainfall and high runoff storm events.

The fishery resources and other sensitive aquatic species in Keswick Reservoir and in the Sacramento River below Keswick Dam are the primary natural resources at risk to the continuing uncontrolled IMM heavy metal discharges from the Site. The exceedance of water quality standards and the accumulation of toxic sediments downstream of IMM contribute to the risks to species in the areas impacted by IMM releases. As a result of past mining activities and current IMM AMD releases, the affected water bodies upstream of the Spring Creek Debris Dam (SCDD) are essentially devoid of aquatic life and amphibians, which are dependent upon that aquatic life. The releases also pose a potential threat to human health.

I.4 Adjacent Land Uses

The adjacent land is largely undeveloped wilderness property that is currently infrequently visited because of the rugged topography and scarcity of roads. Off-road vehicles have been known to visit these areas, and the U.S. Bureau of Land Management (BLM) has notified EPA with regard to potential acquisition of adjacent lands for preservation as wilderness and enhancement for recreational use.

I.5 Natural Resources Uses

The natural resources on the mining property and in the surface waters which flow on or adjacent to the mining property at one time included mature stands of timber, fish, other aquatic populations, and sulfide minerals. The IMM Site contains one very large mass of nearly pure sulfide, several small sulfide deposits, several zones of disseminated sulfides, and a large gossan. The mineral deposits are contained in a rhyolite bedrock. The gossan is a rock zone from which sulfides have been almost completely removed by natural solution, leaving a residue of iron and other metals. The gossan has been mined by open pit for residual metals. The sulfide deposits have been mined in open pit and underground openings for copper, cadmium, zinc, and pyrite. Commercial mining at the IMM Site started in 1879 and

continued with few interruptions until 1963. In the early twentieth century, the Site was one of the largest copper mines in the United States. At that time, mineral extraction objectives and methods varied widely at the Site. In recent years metal recovery activity at the Site has been limited to extracting copper from the AMD using copper cementation.

The valuable natural resources in the downgradient Sacramento River include the Sacramento River fishery, recreational use of the river and the Keswick Reservoir, and the water resource itself, which is a major component of the U.S. Bureau of Reclamation's (USBR's) water distribution system in California.

The portions of Boulder Creek, Slickrock Creek, and Spring Creek impacted by IMM AMD are essentially lifeless. Spring Creek Reservoir was constructed in part as a mitigation measure for the AMD discharges and does not support aquatic life, nor is it currently used for any recreational purpose. The portion of Keswick Reservoir affected by IMM AMD has reduced recreational value. The resident trout fishery in Keswick Reservoir and the main body of the Sacramento River is impacted by both the heavy metal contaminants in the water column of the mixing zones and the heavy sediment loading caused by the precipitation of iron and other heavy metals discharged from IMM over the past century.

The upper Sacramento River salmon fishery is the most important fishery in the State of California. The salmon fishery has experienced large population declines because of a number of factors, including the IMM AMD impacts. The Sacramento River also supports a major steelhead trout and resident trout fishery.

The IMM AMD discharges impact the beneficial uses of the Central Valley Project (CVP) water resources. The CVP is a central component of the California water distribution system. Shasta Lake, which is above the influence of IMM, plays an important role in California's water distribution system for California's municipal and agricultural interests. The high metal loads from IMM require large volumes of dilution water to dilute the pollution to levels that are safe for the affected resources. The large pollution loads generated at IMM have required emergency releases of clean water from Shasta Lake to dilute the IMM AMD. For example, in 1992 the USBR released more than 92,000 acre-feet of water during the sixth year of a drought to dilute a spill of IMM-contaminated waters. This amount of water is sufficient to supply the water demand for 360,000 people for one full year.

Currently, the SCR is relied on to meter the Spring Creek watershed surface waters, contaminated by the continuing uncontrolled IMM AMD area source discharges, into the Sacramento River at Keswick Reservoir. The SCR, coupled with the prior CERCLA response actions implemented pursuant to ROD1, ROD2, and ROD3, provides some degree of protection to aquatic resources and public health below the SCR, but IMM AMD discharges continue to harm and pose risks to aquatic resources and human health in Keswick Reservoir and the Sacramento River (particularly during certain storm events when discharges from the Site are greatest). Under certain conditions, the intense hydrology of the Spring Creek watershed and the highly polluted IMM AMD overwhelm the ability of the SCR to contain releases until they can be safely diluted. When the SCR is full, IMM AMD spills uncontrollably into Keswick Reservoir and the Sacramento River.

The SCR is currently operated to target certain interim metal levels below Keswick Dam. These operational targets approximate but do not equal the SBPS. If the SCR were operated to target compliance with a more stringent standard such as the SBPS or the Proposed California Toxics Rule (PCTR), water would be metered at a slower rate from the SCR, which in turn would cause the reservoir to fill and spill more frequently. Under current conditions, uncontrolled SCDD spills are expected to occur on average every 3 to 4 years if the SCDD is operated to achieve the SBPS below Keswick Dam. Operating the SCDD to meet the recently proposed PCTR (below Keswick Dam) would cause the spills to occur ever 2 to 3 years on average. Spills would occur even more frequently if the SCR were operated to target compliance with these standards in Keswick Reservoir rather than downstream of Keswick Dam. Even during non-spill periods, metal levels in the part of Keswick Reservoir closest to the SCDD are toxic to aquatic life for much of the year and many miles of creek above the SCDD are completely devoid of life as a result releases from the site. The frequency of SCDD spills can be reduced by reducing metal loads to SCR (by controlling pollution at Iron Mountain). The lower metal loads to SCR will permit the IMM AMD to be evacuated from the SCDD at a faster rate, which in turn would decrease the frequency of SCDD spills and exceedances of water quality criteria.

A major portion of the sulfide minerals remains in the mines and in undeveloped areas. The market for sulfide minerals has not been attractive in recent years, and there is no verified proposal to mine these deposits in the near future.

The timber that remains at IMM is not a valuable resource. The timber has either been removed for the mine operations or sale or it was extensively damaged by smelter operations in the early 1900s.

I.6 Location of and Distance from Human Populations

Iron Mountain Mine is relatively remote from human populations because of the rugged terrain and the single-access roadway. The City of Redding has a population of approximately 70,000 people and is located approximately 9 miles from the Site. The closest community is Keswick, located just east of the Site. There are several isolated residences between Keswick and the mine property. The EPA has provided metal gates, which are locked at most times, to discourage casual entry to the Site. Currently, human contact with surface waters impacted by IMM contaminant discharges is mainly limited to areas downstream of the SCDD, which include Keswick Reservoir and the Sacramento River below Keswick Dam.

I.7 General Surface-Water and Groundwater Resources

Iron Mountain Mine surface drainage includes Boulder Creek, located northeast of the mountain, and Slickrock Creek, located to the southwest. Boulder Creek and Slickrock Creek flow into Spring Creek, which flows south and east to the SCR. The USBR releases flow into the Sacramento River from the SCR. Flat Creek drains an area to the east of Iron Mountain and enters the Sacramento River approximately 0.8 mile north of Spring Creek. As a result of a water diversion project constructed in 1990 as part of the CERCLA response at Iron Mountain, Flat Creek also receives water from Upper Spring Creek.

Slickrock Creek drains the south side of Iron Mountain and flows generally from the northwest to the southeast. The headwaters of Slickrock Creek are at about Elevation 3200 feet.

The creek flows about 3 miles to its confluence with Spring Creek at Elevation 1350. The stream carries water from several small ephemeral tributaries as well as discharges from Old/No. 8 Mine Seep and Big Seep, 200 to 300 feet upstream. Slickrock Creek also receives drainage from Brick Flat Pit. The average daily flow of Slickrock Creek at its confluence with Spring Creek is 9.4 cubic feet per second (cfs) (4,200 gallons per minute [gpm]).

The rainfall-runoff varies significantly between and during storm events. The amount of runoff is dependent on antecedent moisture conditions, storm intensity, the vegetative cover, ground slope, length of distributing area, and geology. Major storm events produce a rapid rise in water levels in the creeks.

The rhyolite rock that makes up IMM is very dense, with two to three sets of joints and a number of faults. The rock mass lacks significant porosity because of joint/fault discontinuities. The sulfide mass deposits were largely isolated from the groundwater before mining because the joints generally do not extend from the rhyolitic rock into the mineralized zone. Groundwater was present in the disseminated sulfide zones. Mine openings and fracturing caused by ground movements induced by mining have created access routes for the groundwater to the large volumes of massive sulfide deposits and have increased groundwater access to the disseminated sulfide mineralization. The additional groundwater movement and increased circulation of air within the mountain has greatly accelerated the process of sulfide dissolution and the formation of metal-rich acid mine drainage.

Surface water and groundwater at Iron Mountain were previously used for mining operations and to provide water supply to the mine staff and their families. These resources are essentially unused today because the mines are inactive and surface waters are being contaminated by AMD.

I.8 Surface and Subsurface Features

The largest sulfide ore mines on Iron Mountain include an open pit mine at Brick Flat, underground workings at Old Mine, No. 8 Mine, the Confidence-Complex Mine on the southern flank of the mountain, and the Richmond and Hornet Mines on the northern flank. The Slickrock Creek drainage mines include the Old Mine, No. 8 Mine, Confidence Mine, and the Okosh Mine. The Old Mine and No. 8 Mine have had more significant mining operations and are considered more significant sources of AMD. The Okosh and Confidence Mines are considered to be less significant sources than the Old Mine and No. 8 mine but do discharge AMD during certain periods.

Old Mine was developed to mine portions of a gossan deposit which could not be reached by quarrying. The mine is under the north slope of Slickrock Creek Valley with the mine workings ranging from the elevation of the lower slope to well below the elevation of the adjacent reach of Slickrock Creek. Mining in the Old Mine relied upon a method of underground mining called slice stoping. The ore was removed in 7-foot-high layers working from the bottom toward the top of the deposit. A working surface was maintained by progressively backfilling the mined opening with rock rubble returned to the mine through dropholes from the ground surface. The extent of the backfilling is not clear from the records available, but the volume of remaining voids at the time of closure appears to have been small compared to adjacent mines. The backfilling operation was performed to support the working surface,

was highly porous, and did not re-establish the pre-mining, undisturbed hydrologic conditions that would serve to reduce the rate of pyrite oxidation. In fact, the temperature of sulfides in the backfilled areas of the mine was so high, resulting from the ongoing oxidation reactions, that the sulfide minerals regularly caught on fire, presenting a severe safety hazard to miners.

The ore deposit of the No. 8 Mine is at the level of the middle of the north slope of Slickrock Creek Valley. The intervening 300 feet of rock has little or no sulfide mineralization. The ore is a mass of rock with disseminated chalcopyrite mineralization in veins. In contrast, the other mines on the IMM Site consist of massive sulfide or massive disseminated ore bodies. The No. 8 Mine consists of three levels of tunnels and small- to moderate-size openings which follow the veins. The mine is as high as Elevation 2400, but portions are below the elevation of Slickrock Creek. Mining started in 1907 and ended after World War II. Portions of the mine are reported to have been backfilled with waste rock or tailings slime. In order to support this effort to backfill the mine openings, the No. 8 Adit was plugged. Although the attempt to backfill the No. 8 Mine with gossan slimes was essentially unsuccessful, plugging the mine opening has resulted in the flooding of the underground workings to a level approximately 100 feet above elevation of the No. 8 Adit. This discharge emerges from the massive Slickrock Creek debris slide as the Old/No. 8 Mine Seep. An estimated 1.7 million tons of ore was extracted from the Old and No. 8 Mines.

The Brick Flat open pit mine was operated between 1929 and 1942 for gossan and from 1955 to 1962 for pyrite. Approximately 500,000 tons of ore were extracted. Millions of tons of overburden containing low grade, disseminated mineralization were dumped into Slickrock Creek in the effort to expose the ore in Brick Flat Pit. Most of the overburden and waste rock was placed in a large waste pile south of the pit and above the north slope of Slickrock Creek Valley. In 1955, a large landslide of these materials moved into the Slickrock Creek Valley, covered the Old Mine and No. 8 Mine portals, and filled the valley bottom to a depth of 80 feet. A comparison of old and recent topographic maps indicates that the present bed of Slickrock Creek is about 40 feet south of the bed prior to the large, mining-induced slide. The slide surface is presently almost devoid of vegetation, suggesting continued sliding.

Significant portions of the gossan cap on Iron Mountain were mined to recover gold and silver in a heap leaching operation. Approximately 2.7 million tons of gossan were extracted, crushed, and processed for recovery of precious metals. The extraction of gossan ore required the excavation and wasting of significant amounts of overburden and low grade gossan, which were dumped on steep slopes of the Slickrock Creek watershed or in the creek itself behind tailings dams. The finely crushed wastes from the heap leaching operations were dumped into Hogtown Gulch, forming the enormous waste piles that today are called the hematite piles.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

II.1 History of Site Activities that Led to Current Problem

Iron Mountain Mine was first secured for mining purposes in 1865, and various individuals held the property and conducted limited mining for the recovery of silver from the gossan areas in the late 1800s. The waste-generating activities that created the surface sources of AMD likely began in the 1880s when the gossan was first mined on a large scale, and waste

rock that was removed to reach the ore was apparently dumped into ravines and eventually washed into the creeks.

Beginning in late 1894, Mountain Mining Co., Ltd. (Mountain Copper), began operation of the mine. In approximately 1896, Mountain Copper assumed ownership of the mine. Under Mountain Copper, IMM became the largest producer of copper in California and the sixth largest producer in the country during the first quarter of the twentieth century. High-grade copper ore was mined in Old Mine until 1907, No. 8 mine from 1907 until as late as 1923, Hornet Mine from 1907 to 1926, the Richmond Mine from 1926 through 1956, and Brick Flat Pit from 1929 to 1942 and 1955 to 1962.

In 1967, Stauffer Chemical Co. (SCC) acquired Mountain Copper. In 1968, SCC obtained legal title to the properties comprising IMM from its wholly owned subsidiary, Mountain Copper Company, Ltd. SCC originally took steps to reopen the mine, but the price of sulfur dropped to a point that caused the option to be uneconomical. SCC operated the copper cementation plant on Boulder Creek during its ownership of the Site and continued to investigate the commercial mining potential of the property. In November 1976, the Central Valley Regional Water Quality Control Board (CVRWQCB) issued an order to SCC requiring the abatement of the continuing pollution from the mountain.

In December 1976, SCC transferred ownership of 31 parcels on Iron Mountain to Iron Mountain Mines, Inc. (IMMI), and in December 1980, SCC transferred five additional parcels to IMMI. IMMI, a California corporation, is the current owner of Iron Mountain, but SCC retained ownership of certain property interests at the Site. IMMI constructed a copper cementation plant on Slickrock Creek in 1977. IMMI has intermittently operated this plant and the copper cementation plant on Boulder Creek to recover copper from the AMD.

II.2 Impacts of Mining Activity at Iron Mountain

Mining activities have fundamentally altered the geochemical and hydrologic conditions at Iron Mountain. In an undisturbed condition, a series of geologic and geochemical factors combined to permit the several large masses of sulfide mineralization to remain in place below the water table over geologic time. Now that mining has altered those conditions, however, the massive mineralization is no longer protected by the water table from oxidation, which in turn has exposed the mineralization to conditions that permit the rapid (on a geologic time scale) oxidation and release of acidity and metals from that deposit. Although the mineral deposit was formed about 400 million years ago, mining has accelerated the rate of oxidation such that it will now take only about 3,000 years to deplete the entire deposit. These mining-induced changes are the source of the severe pollution problem at IMM.

When pyrite is exposed to moisture and an oxidant (such as free oxygen or an aqueous ferric iron), the pyrite oxidizes and releases acidity. This acidity mobilizes metals, such as copper, cadmium, and zinc, into solution. The overall driving force for this reaction is the accessibility of an oxidant, either in the form of free oxygen or some other oxidant such as aqueous ferric iron. The rate at which pyrite oxidizes is limited by the access of the pyrite to oxidants. The oxidation of pyrite produces an iron oxide material or gossan.

Prior to mining, a gossan cap and relatively impervious bedrock protected the fresh mineralization (i.e., unoxidized pyrite) from extensive oxidation. Although relatively small amounts of pyrite and metal exist within the weathered gossan on the surface, those materials did not generate appreciable amounts of heavy metals and acidity relative to current conditions. The undisturbed gossan provided a protective shell that limited the access of water and oxygen to the residual unoxidized pyrite and metals locked within the gossan.

The undisturbed gossan contained preferential flow paths that conveyed rainfall as runoff to the creeks. These flow paths would typically be highly weathered by exposure over geologic time. Since they were highly weathered, the flow paths would permit rainfall to move quickly through the gossan without becoming highly acidic. These preferential flow paths also channeled water along the surface so rainfall tended to not penetrate to deeper areas where unoxidized mineralization was present. Water traveling through highly weathered gossan therefore contains essentially no dissolved metals or acidity.

In the undisturbed condition, the fresh (i.e., unoxidized) mineralization at IMM was largely below the water table and therefore isolated from conditions (namely, both free oxygen and water) that permit the formation of highly acidic and metal-laden AMD. While limited oxidation occurred near the contact between the iron oxides of the gossan and the fresh massive sulfide, numerous factors combine to severely limit the flow through the area of oxidation as well as the rate of oxidation. In an undisturbed mineralized environment, the hydrology typically permits only a small fraction of the groundwater to contact the mineralization deep below the surface because, with depth, the ground tends to become less permeable and less fractured. When fractures do occur at depth in undisturbed mineralization, the fractures tend to be highly localized, which in turn restricts the flow of water and oxygen into and out of the fracture. Buildup of oxidation products (i.e. clays) within the area of oxidation would also act to limit the infiltration of fresh water to the zone, which would act to further restrict the flow in the area of oxidation. The steep topography at Iron Mountain further limits the introduction of groundwater because a greater portion of rainfall would be expected to run off rather than infiltrate the mountain. Furthermore, the water that does infiltrate will be subject to very high hydraulic gradients promoting groundwater flow to the creeks rather than to the relatively deep oxidation zone under natural conditions.

As groundwater infiltrates below the groundwater table and the zone of active oxidation, oxygen is depleted and the groundwater becomes reduced. In this reducing environment, soluble copper from the oxidized zone is immobilized as secondary copper sulfides. Since secondary sulfides retain at least some of the metals, metals are not entirely released from the massive sulfide to the groundwater entering Boulder and Slickrock Creeks.

Mining activities at Iron Mountain changed these conditions in profound ways. Mountain Copper employed stoping, block caving, and room-and-pillar mining techniques in the underground mines; side-hill and open-pit techniques were used at the ground surface. The extensive mine disturbance in the Slickrock Creek basin is shown in Photo Exhibit 1, located at the back of this Record of Decision. These mining activities and subsequent collapse of some of the underground mine workings have fractured the bedrock overlying the mines. The sulfides in the fractured bedrock above the mines and the sulfides remaining in the mines are, in the post-mining period, more exposed to water, air, and bacterial action. The potential

for acid drainage and metals contamination is greater than prior to mining and, since the mining ceased, this potential may have increased in response to deterioration of the ground over the abandoned mines.

The engineered mine openings and the partially collapsed mineralized zones affected by mining activity now function as effective groundwater drains drawing groundwater and unsaturated percolation to and through the sulfide mineralization. Prior to mining, groundwater movement through this area would have been quite limited relative to current conditions. The increased flows through these unoxidized areas altered the rate of oxidation in these areas. Increased flows resulted in releases of acidity and metals above the levels that existed before the mining disturbance.

Mining also altered the release of metals and acidity by exposing sulfides that were once largely below the water table (and therefore not exposed to free oxygen or another oxidant) to conditions that permit the rapid oxidation and release of metals and acidity. Mining activities lowered the groundwater table through channeling groundwater through engineering mine workings, mine fractures, and other mine disturbances. The lowering of the groundwater table exposes fresh sulfides to free oxygen and water (where prior to mining these sulfides were not exposed to free oxygen because they were under water). The lowering of the groundwater table therefore increases the rate of oxidation and release of acidity and metals.

The increased oxidation of the sulfide elevates the overall temperature in the sulfide mineralized zone because the reaction is exothermic. The increased heat associated with these higher reaction rates induces convective airflow, and likely induces evaporation of some subsurface mine waters. These processes contribute to the intensity and pattern of acidic discharges.

Mining also increased the oxidation rate of gossan by fracturing, crushing, pulverizing and otherwise breaking the gossan, which in turn exposes the residual metals and pyrite within the gossan to greater flows of water and oxidants.

These mining-related characteristics, in combination with the occurrence of the highly concentrated massive sulfide deposits surrounded by bedrock with very little neutralizing capacity, result in a unique hydrogeochemical reactor that is nearly optimal for maximum production of acid mine waters. Iron Mountain produces runoff that is among the most acidic in the world, containing extremely elevated concentrations of copper, cadmium, zinc, and other metals known to be toxic to aquatic life and humans.

Mining has changed not only the pH and the concentration of heavy metals in the receiving waters, but also the pattern of release of hazardous substances. Prior to mining, the metal and acidity releases that did occur would have been diluted releases associated with surface runoff from the highly weathered surfaces of Iron Mountain and groundwater that would have not been exposed to highly reactive mineralization (because the elevated water table would submerge unreacted sulfides, excluding oxygen and inhibiting the oxidation reaction). In contrast, the post-mining discharges include surface runoff that percolates through enormous highly porous waste piles, disturbed soils, and surface mining areas; groundwater that percolates through fractured geologic systems in contact with highly reactive mineralization

exposed by the depressed water table; and significant discharges of highly concentrated AMD issuing from the mine workings that results from inflow of near-surface waters deep into the fractured mineralized zones through conduits of collapsed and caved ground. These disturbances therefore create the intense peak metal discharges associated with high-flow events, in addition to the high metal loads associated with low-flow conditions.

The sources addressed by the action selected in this Record of Decision include the area sources in the Slickrock Creek watershed. These sources include waste piles, sidecast spoils, ground disturbed by mining-related activities, discharges from buried workings or partially accessible workings, mine-contaminated soil and debris, mining-related seeps, mining-contaminated interflow and groundwater, and mining-contaminated sediments in the Slickrock Creek watershed at IMM. These sources have clearly been altered by mining. Photo Exhibits 1 and 2 (located at the back of this Record of Decision) illustrate both the extent of mining disturbance in the area being remediated and the degree to which the response action is focused upon the most heavily disturbed portion of the Slickrock Creek basin. Among the sources being remediated, EPA is aware of no identifiable release or threat of release of a naturally occurring substance in its unaltered form, or altered solely through naturally occurring processes or phenomena, from a location where it is naturally found.

II.3 Central Valley Project-Related Impacts

The Sacramento River is a primary water resource for much of the State of California. As growth increased the demand for water, the importance of the Sacramento River has grown as well. The increasing demand for scarce water resources, coupled with a growing understanding of the sensitivity of aquatic resources to trace levels of toxic metals present in the Sacramento River as a result of past mining activities, has increased the significance of IMM AMD impacts in the Sacramento River.

In response to the growing demand for water and the need to control flood waters, the USBR constructed the Shasta Dam to control Sacramento River flows. USBR completed the Shasta Dam in 1943 and the Keswick Dam, located downstream of Shasta Dam, in 1950. Construction of the dams changed the conditions in the Sacramento River. Once USBR completed the Shasta and Keswick Dams in 1950, the salmon and steelhead were restricted to spawning grounds in areas downstream of Keswick Dam, which is one of the areas of the Sacramento River with the greatest exposure to AMD discharges from Iron Mountain (the other area being Keswick Reservoir). The dam also reduced the availability of dilution flows at certain times, which would tend to increase the metal concentrations in the river. While the Shasta and Keswick Dams changed the river system, toxicity problems are documented both before and after the completion of Shasta Dam in 1943. Only limited water quality information is available from the pre-Shasta period, but water quality modeling and the limited available data indicate that, prior to the construction of the Shasta Dam, the IMM mine discharges caused metal levels in the Sacramento River to exceed levels that are safe for aquatic life for more than 330 days each year on average, even after the releases become fully mixed with Sacramento River waters downriver of the confluence of Spring Creek and the Sacramento River. Prior to full mixing, the waters would have been even more toxic to exposed resources.

In 1963, USBR constructed the SCDD to help control the toxic releases from Spring Creek and to prevent sediment from forming a delta in the vicinity of the Spring Creek Powerplant tailrace. The SCDD allows for the storage and controlled release of water from the Spring Creek basin. Optimally, releases from SCR are timed to coincide with releases from Shasta Lake to meet interim water quality criteria in the Sacramento River. However, because the capacity of SCR is not sufficiently large to contain peak discharges from the Spring Creek watershed, large flows can cause the highly polluted SCR waters to spill over the reservoir in an uncontrolled manner. The SCDD has reduced but not eliminated the incidence and severity of major fish kills in the Sacramento River below Keswick Dam and in Keswick Reservoir. As a result of discharges from IMM, soluble metal levels below Keswick Dam can be just below the State Basin Plan Standards (SBPS) for much of the wet season, and metal levels in the Spring Creek arm of Keswick Reservoir (SCAKR) exceed those standards on a regular basis. (See EPA's 1996 *Water Management Feasibility Study Addendum* (FSA), Volume II, Appendix G.) As would be expected from these large metal loads, fish tissue samples from Keswick Reservoir trout have some of the highest levels of cadmium and copper in the state.

The most significant IMM sources of metals are currently being controlled, but the IMM releases are still too large to prevent toxic levels of metals in Keswick Reservoir and, under certain conditions, in the main stem of the Sacramento River below Keswick Dam. During storms in 1995 and 1996, SCR waters, with full treatment of the three major mine discharges (which EPA estimates controlled approximately 80 to 90 percent of the metal load from the Site), exhibited levels of contamination of 400 to 800 parts per billion (ppb) dissolved copper (compared to the existing SBPS of 5.6 ppb copper) and 600 to 1,200 ppb dissolved zinc (compared to the existing SBPS of 16 ppb zinc). Storm inflows into the SCR can exceed 1,000 cfs. Sacramento River flows are frequently near minimum legal flows during the first storm of the season, or not more than 10,000 cfs. Under these conditions, the Sacramento River flows cannot provide sufficient dilution of the IMM AMD-contaminated Spring Creek watershed surface waters at current levels of contamination to prevent the IMM discharges from causing exceedances of water quality standards in the Sacramento River. At the current status of the IMM Superfund cleanup action, with full-scale treatment of the three major IMM sources, IMM discharges will continue to cause exceedances of water quality standards below Keswick Dam even under best-case assumptions regarding SCDD operations.

The two most important factors which currently make it impossible for the SCDD to permit dilution of IMM AMD in a manner that maintains water quality conditions in the Sacramento River within safe bounds for ecosystem protection are: (1) the storm inflows to the SCR are highly contaminated from IMM, and (2) storms that cause these contaminated waters to fill the reservoir within just a few days will likely occur every 5 to 10 years. Significant further remediation of the IMM area source AMD discharges is required to ensure that the existing SCDD will be able to provide sufficient capacity to avoid exceedances of water quality standards below the SCDD.

II.4 History of Federal and State Site Investigations

Remedial investigation (RI) activities at Iron Mountain began in September 1983, when Iron Mountain was placed on the National Priorities List of the nation's most contaminated sites.

In conjunction with EPA's Record of Decision (ROD1) for the first operable unit at Iron Mountain, EPA issued a remedial investigation/feasibility study (RI/FS) report in 1985 and an FS Addendum in 1986. The 1985 RI report characterized the entire IMM Site with respect to the nature and extent of contamination. The EPA's Public Health Risk Assessment was updated in 1991. Site characterization studies continued for the Boulder Creek watershed, and EPA prepared a second RI/FS report for that area in 1992. An Endangerment Assessment (EA) was prepared in 1992 to characterize and evaluate the current and potential threats to the environment that may be posed by IMM contaminants migrating to the groundwater, surface water, and air. Site characterization studies continued for the Slickrock Creek watershed, and EPA prepared an RI/FS report for that area in 1993. The EPA issued its Water Management FS in 1994, the Boulder Creek Remedial Alternatives Study in 1995, and the Water Management FS Addendum in 1996.

The EPA signed the first Record of Decision for the IMM Site in October 1986. ROD1 selected an interim remedy at the Site, identifying a number of specific projects. These projects included the construction of a partial cap over the Richmond mineralized zone, including a cap of Brick Flat Pit; construction of a diversion in Slickrock Creek to avoid an AMD-generating slide; construction of a diversion of the Upper Spring Creek to avoid polluting its cleaner water and filling SCR; construction of a diversion of the South Fork of Spring Creek for a similar purpose; a study of the feasibility of filling mine passages with low-density cellular concrete; and an enlargement of SCDD, the exact size of which would be selected after a determination of the effectiveness of the other remedies. EPA tentatively selected a 9,000-acre-foot reservoir size in ROD1 although the underlying studies indicated that a 15,000-acre-foot reservoir would be required for a protective remedy. In its tentative selection of a smaller reservoir size, EPA relied on a fund-balancing waiver, which permits EPA to waive compliance with protective standards for cleanups that are being paid for by the Superfund.

The Boulder Creek Operable Unit (OU) ROD, signed in September 1992, addressed remedial actions for (1) AMD from the Richmond and Lawson portals, the two largest sources of acidity and metals contamination at Iron Mountain; and (2) the numerous waste rock piles, tailing piles, seeps, and contaminated sediments that also affect contaminant levels in Boulder Creek. The Old/No. 8 Mine Seep OU ROD, signed in September 1993, addressed the third largest source of contaminant discharges at IMM.

On the basis of the results of its ongoing monitoring program, EPA concluded that the area source discharges of heavy metals, especially copper, zinc, and cadmium, were closely associated with the intense storm-related high runoff events that characterize the hydrology of the Spring Creek watershed at IMM.

Through a formal action in 1991 known as an explanation of significant difference (ESD), EPA revoked the fund balancing waiver upon which EPA relied for ROD1. This formal action removed the legal basis for EPA's tentative selection of a 9,000-acre-foot reservoir in ROD2 in lieu of a larger, more protective dam. Consistent with the SCDD enlargement component of ROD1 and the ESD, EPA conducted engineering and other studies regarding enlarging the SCDD. These studies indicated that a reservoir of at least 15,000 acre-feet would be required. Due to the projected increased costs of the SCDD enlargement and the availability of other new information, EPA decided to expand its studies, re-evaluate other

remedial technologies, and publish for public review and comment a new feasibility study and proposed plan.

In June 1994, EPA published a Water Management FS, which examined potential remedial alternatives that could control, treat, or manage the safe release of continued uncontrolled contaminant discharges from the numerous and widely dispersed area sources in the Boulder Creek and Slickrock Creek watersheds at IMM. In the 1994 Water Management FS, EPA developed five alternatives for detailed evaluation. These alternatives included a range of approaches that relied on source control, collection and treatment, and water management technologies. Although some area sources could be readily identified and remediated (such as waste piles), a large proportion of the area source discharge was, in general, difficult to identify and characterize. Proven cost-effective, source-specific remedial approaches for these sources are often either unavailable or difficult to identify. Generally, the expected effectiveness of identified source control approaches for these sources is highly uncertain. As a result, the approaches used in the remedial alternatives developed and evaluated in the Water Management FS relied more heavily on collection and treatment and water management rather than on source control..

In June 1994, EPA issued a Proposed Plan with a set of remedial actions for the IMM area source AMD discharges. The Proposed Plan largely relied on a water management approach, with some additional treatment of IMM AMD discharges, consisting of the following three components:

1. Collect and treat the contaminated base flows of Slickrock Creek;

2. Enlarge the SCR to 15,000 acre-feet to enhance water management capabilities for the Site; and

3. Study the technical and administrative feasibility of purchasing dilution water to mitigate the rare contaminant spills that would be expected to occur under this approach.

The EPA invited public comment on EPA's analyses, the alternatives that EPA developed and evaluated, and EPA's preferred alternative.

During the public comment period for the 1994 Proposed Plan, a potentially responsible party (PRP), Rhone-Poulenc, Inc. (Rhone-Poulenc) (through its representative, Stauffer Management Company [SMC]) submitted a Focused Feasibility Study (FFS). Like the EPA feasibility study, the FFS identified a range of general collect and treat alternatives for the area source releases from the Slickrock Creek watershed. Rhone-Poulenc urged EPA to delay selecting a remedy so that an additional season of data could be collected.

The EPA reviewed and analyzed the alternatives developed in Rhone-Poulenc's 1994 FFS, as well as other comments submitted during the comment period. The EPA determined that delay in remedy selection was justified because the information submitted by Rhone-Poulenc suggested that it was technically feasible (and also more cost-effective) to control the IMM pollution on the mountain rather than simply diluting pollution by enlarging the SCDD.

This delay permitted Rhone-Poulenc and EPA an opportunity to collect additional data. Over the 1994-95 wet season, Rhone-Poulenc implemented a substantial data-gathering program to characterize the IMM area source AMD discharges. This data acquisition program included activities intended to identify and characterize Boulder Creek area sources to support an effort to develop and evaluate source-specific remedial approaches. Rhone-Poulenc did not investigate source-specific controls for the Slickrock Creek area sources, but rather directed its efforts toward general collect and treat approaches such as the Slickrock Creek dam and treat approach. Rhone-Poulenc performed engineering studies intended to further characterize and define key hydrologic and engineering factors for the development and evaluation of the Slickrock Creek "dam and treat" approach. Rhone-Poulenc also developed remedial design concepts for proposed Slickrock Creek and Boulder Creek remedies. The data collected by Rhone-Poulenc confirmed EPA's earlier determination that additional response actions were needed to control the releases from IMM (as well as EPA's estimates of the effectiveness of the remedial steps implemented to date).

The EPA also performed independent engineering, laboratory, and field studies and reviewed and prepared analyses of the data generated by the Rhone-Poulenc sampling effort. The EPA participated in technical meetings with Rhone-Poulenc to develop remedial design concepts for a Slickrock Creek "dam and treat" remedy.

To ensure that technically implementable remedies were available for the Boulder Creek watershed, EPA conducted a Boulder Creek Remedial Alternatives Study in 1995, which evaluated the technical feasibility of remediating Boulder Creek area sources to various target cleanup levels. Rhone-Poulenc also studied the feasibility of remediating Boulder Creek area sources. Both EPA's and Rhone-Poulenc's studies concluded that the Boulder Creek area sources could be remediated to within the range of potential target cleanup levels presented by EPA as part of the 1995 Boulder Creek Remedial Alternatives Study.

In August 1995, EPA and Rhone-Poulenc presented their respective analyses and conclusions with regard to the ongoing Boulder Creek studies to a panel of senior technical specialists for review and technical comment. The EPA requested that the panel evaluate the feasibility of remediating the Boulder Creek area sources to achieve a range of potential cleanup criteria. The Boulder Creek Peer Review panel members concurred that the range of potential cleanup targets for Boulder Creek could be met through a program of Boulder Creek remedial actions. The independent peer review panel members' comments presented a range of opinions on the preferred technical approach for remediating the Boulder Creek metal discharge sources. Consistent with the panel comments, EPA concluded that adequate control of the Boulder Creek area sources was feasible, but deferred action on developing and evaluating proposed remedial approaches for these sources to allow time for additional study.

The EPA incorporated these and other investigations into a Water Management Feasibility Study Addendum (FSA) in May 1996. The FSA evaluated an additional remedial alternative as a supplement to the June 1994 Water Management Feasibility Study. EPA's May 1996 Public Comment Water Management FSA updated the public record to include an evaluation of an alternative that addressed only the remediation of Slickrock Creek, Alternative SR1. The 1994 FS evaluated remedial options that would respond to all AMD releases from the Site. In particular, the alternatives would have addressed both the Slickrock and Boulder

Creek sources through source control, treatment, or water management remedial approaches. In May 1996, EPA formally announced that it proposed to select Alternative SR1 as its "Preferred Alternative" for the contaminated Slickrock Creek flows. The EPA proposed to perform additional studies regarding the Boulder Creek area source AMD discharges to support further development and evaluation of alternatives for decision making.

II.5 History of CERCLA Enforcement Activities and Remedial Actions

The EPA's Superfund program became involved with the Iron Mountain pollution problem shortly after the enactment of the Superfund law in December 1980. On April 5, 1982, EPA issued general notices of liability to SCC and IMMI for the past and continuing releases of hazardous substances from Iron Mountain and the resulting damage to and destruction of natural resources.

The IMM Site was listed on the National Priorities List in 1983. From 1983 through 1985, EPA conducted an RI/FS of the Site and published its report in 1985. After public comment and publication of a Feasibility Study Addendum, EPA signed ROD1 in October 1986. That ROD selected an interim remedy at the Site, which included a number of specific projects. These projects included the construction of a partial cap over the Richmond mineralized zone, including a cap of Brick Flat Pit; construction of a diversion in Slickrock Creek to avoid an AMD-generating slide; construction of a diversion of the Upper Spring Creek to avoid polluting its cleaner water and filling SCR; construction of a diversion of the South Fork of Spring Creek for a similar purpose; a study of the feasibility of filling mine passages with low-density cellular concrete; and an enlargement of SCDD, the exact size of which would be selected after a determination of the effectiveness of the other remedies.

During 1987 and 1988, EPA sought a court order to ensure access to the Site for the purpose of constructing the first of these actions. The court granted EPA access and ordered the property owner not to interfere with the remedial actions. On July 19, 1988, EPA initiated construction of the partial cap over the Richmond mineralized zone. As part of that construction, EPA remediated tailings materials from the Minnesota Flat area and other selected areas, by placing the materials into Brick Flat Pit below an impermeable membrane or "cap." The EPA completed construction of the partial cap in July 1989. The EPA, through the USBR, began construction of the Slickrock Creek diversion in July 1989 and completed construction in January 1990. Under EPA Administrative Order 90-08, Rhone-Poulenc, the successor to Stauffer Chemical Company (through its indemnitor, ICI Americas, Inc. [ICIA]), began construction of the Upper Spring Creek (USC) diversion in July 1990. The USC diversion became operational in January 1991.

In addition to the activities implemented pursuant to ROD1, EPA recognized the need for additional actions. During the 1988-89 wet season, EPA operated an emergency treatment plant at the Site to reduce the toxicity of the AMD releases.

In August 1989, EPA issued Administrative Order 89-18, which required the PRPs to operate an emergency treatment plant at the Site to reduce the toxicity of the AMD discharges for the upcoming 1989-90 winter wet season and to provide for metals removal for future years until remedial actions could be selected and implemented. This plant was to be comparable in scope and operation to the plant operated by EPA the previous winter. Pursuant to that order,

ICIA, on behalf of Rhone-Poulenc, constructed the treatment plant and operated this treatment plant during the 1989-90, 1990-91, and 1991-92 wet seasons. Because of the continuing drought in California and the critical fishery conditions, EPA issued Administrative Order 92-26 on September 2, 1992, for the 1992-93 wet season, requiring that additional emergency measures be implemented, including increasing the capacity of the treatment plant. The EPA also issued Administrative Order 91-07, requiring the PRPs to operate and maintain EPA-constructed remedial actions and the remedial projects undertaken by the PRPs under other orders.

As part of its ongoing efforts to control the AMD from IMM, EPA conducted an operable unit feasibility study (OUFS) to develop and evaluate remedial alternatives for the AMD discharges in the Boulder Creek watershed. The EPA's 1992 RI report summarizes the data which show the concentration, volume, and historic patterns of releases of AMD from the Boulder Creek watershed at IMM. On September 30, 1992, EPA signed ROD2, a Record of Decision that selected treatment of the AMD discharges from the Richmond and Lawson portals, the two largest AMD discharges at IMM, on an interim basis in a lime neutralization HDS treatment plant. That Record of Decision also selected the consolidation and capping of seven waste piles onsite. Under ROD2, treatment plant sludges are to be disposed of onsite in the inactive open pit mine, Brick Flat Pit, which was modified to comply with applicable disposal standards.

On November 3, 1992, EPA issued Administrative Order 93-01, requiring the PRPs to design and construct all necessary facilities to collect, convey, and treat the discharges of AMD from the Richmond and Lawson portals (including facilities for disposal of treatment sludges). Administrative Order 93-01 also required the PRPs to excavate, consolidate, and cap seven waste piles. Pursuant to that order, ICIA, on behalf of Rhone-Poulenc, agreed to design and construct the treatment plant and to excavate, consolidate, and cap the seven waste piles. However, ICIA opposed EPA's selection of the HDS process technology and performed studies to support its position that the HDS components to the treatment plant should not be constructed. Instead of requiring Rhone-Poulenc to build the HDS component of the treatment plant selected in ROD2, EPA built that component, reserving its rights to recover the costs of doing so.

The EPA continued to conduct studies to control the AMD discharges from IMM and performed an OUFS to develop and evaluate remedial alternatives for the AMD discharges in the Slickrock Creek watershed. In February 1993, EPA published an RI/FS report summarizing data regarding AMD discharges in the Slickrock Creek watershed. The February 1993 RI/FS developed and evaluated remedial alternatives for the Old/No. 8 Mine Seep AMD discharges. On September 24, 1993, EPA signed ROD3, a Record of Decision that selected treatment of the AMD discharges from the Old/No. 8 Mine Seep on an interim basis at the IMM lime neutralization HDS treatment plant, as appropriately modified.

On April 19, 1994, EPA issued Administrative Order 94-12, requiring the PRPs to design and construct all necessary facilities to collect, convey, and treat the discharges of AMD from the Old/No. 8 Mine Seep. Administrative Order 94-12 also required the PRPs to operate the IMM treatment plant. SMC, on behalf of Rhone-Poulenc, agreed to design and construct the collection and conveyance facilities and the necessary modifications to the IMM treatment

plant to assure treatment of the Old/No. 8 Mine Seep AMD discharges. Rhone-Poulenc also agreed to operate the aerated simple mix components of the IMM treatment plant.

The aerated simple mix treatment plant became fully operational in October 1994. For the past 3 years, the IMM treatment plant has treated essentially all of the AMD discharges from the Richmond and Lawson portals and the Old/No. 8 Mine Seep. EPA constructed the HDS components of the treatment plant, which became operational in January 1997. The EPA has amended Administrative Order 94-12 to clarify requirements pertaining to HDS plant operations.

The EPA and the State of California have brought a civil suit under CERCLA §107 against the PRPs to obtain reimbursement for government funds spent in responding to the IMM AMD discharges. The cost recovery case is ongoing.

The EPA has identified the following persons as PRPs: the former owner and operator, Rhone-Poulenc, Inc. (the successor to Mountain Copper, Ltd. and its subsidiaries, and Stauffer Chemical Company), and the current owner and operator, Iron Mountain Mines, Inc., and its president and primary owner, T. W. Arman.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

The EPA has regularly provided information to the public regarding the Superfund cleanup activities at Iron Mountain. The community has maintained interest in the progress of cleanup at the Site. Prior to the winter wet seasons of 1991 and 1992, community involvement was moderate. Community interest and involvement increased in 1992 as a result of the special release of 92,000 acre-feet of valuable water resources from Shasta Lake to dilute pollution from IMM (during serious drought conditions). Since that time, community and other State and Federal agency interest in the progress of the EPA Superfund cleanup of the IMM AMD discharges has remained significant. Throughout the cleanup activities, EPA has regularly provided information to the local television news and the press regarding the ongoing study and cleanup actions, and this has resulted in significant media coverage. The EPA has provided regular updates on the progress of cleanup actions through the release and distribution of factsheets and through presentations to local community groups.

III.1 Public Participation for Previous RODs

The EPA issued its first Record of Decision for the IMM Site in October 1986. The EPA has issued factsheets regarding that decision and commencement of remedial design (July 1987), commencement of remedial action (July 1988), implementation of emergency response treatment actions (February 1989), and the performance of a demonstration program under EPA's Superfund Innovative Technology Evaluation (SITE) program (August 1991). The EPA also updated its Community Relations Plan, which was finalized in May 1990.

In May 1992, EPA issued a Proposed Plan for the Boulder Creek OU at IMM. The Proposed Plan provided an update on the status of remedial and emergency response activities at the Site. The May 1992 Proposed Plan summarized EPA's development and evaluation of remedial alternatives for the AMD discharges from the Richmond and Lawson portals and invited public comment on EPA's proposed cleanup approach. The EPA held a public meeting in June 1992 to present its Proposed Plan, to answer questions, and to receive public

comments. In September 1992, EPA issued its second Record of Decision for the Site. The second Record of Decision selected the interim treatment remedy described above.

In February 1993, EPA issued a Proposed Plan for the Old/No. 8 Mine Seep OU to address the AMD discharges from this source at IMM. The Proposed Plan provided an update on the status of remedial and emergency response activities at the Site. The February 1993 Proposed Plan summarized EPA's development and evaluation of remedial alternatives for the AMD discharges from the Old/No. 8 Mine Seep and invited public comment on EPA's proposed cleanup approach. The EPA held a public meeting in February 1993 to present its Proposed Plan, to answer questions, and to receive public comments. The EPA issued its third Record of Decision for the Site in September 1993, selecting the interim treatment remedy for these AMD discharges.

In October 1993, EPA issued a Technical Assistance Grant (TAG) to the Shasta Natural Science Association. The grant has provided funding to support the development and dissemination of information to the community regarding EPA's IMM cleanup activities. The TAG was annually extended through March 1997 and has now expired.

III.2 Public Participation for the 1994 Proposed Plan

In June 1994, EPA issued a Proposed Plan to enlarge the SCDD and conduct baseflow treatment of Slickrock Creek area sources (the term baseflow refers to the flow in the creek before, after, and between peak discharge flows related to storm runoff; baseflow treatment was one component of the preferred alternatives from the 1994 Proposed Plan) as the "preferred alternative." During the 60-day public comment period, EPA held a public meeting in Redding, California (July 7, 1994). The proposed action attracted significant community interest and the public meeting was well attended (approximately 50 to 70 private citizens). At the meeting, EPA received oral comments, and several members of the public submitted written comments. The EPA received detailed technical comments from representatives of Rhone-Poulenc. The EPA also received comments from interested State and Federal agencies. In general, the comments from private citizens were supportive of EPA's Proposed Plan. The comments indicated general agreement with EPA's intention to ensure protection of the Sacramento River fishery and water supply. They also indicated agreement with EPA's portrayal of the proposed remedy selection criteria which recognize that cost and technical impracticability factors might limit the extent to which the IMM metals discharge could be controlled and the restoration of the Spring Creek watershed could be implemented.

Other comments included:

- Action should be taken to protect the Sacramento River as soon as possible.
- Action should be deferred until the effectiveness of the IMM treatment plant and the need for additional action could be evaluated further.
- A preference exists for a remedy that would eliminate the metals discharges through controls.

- Continued investigation of such approaches was recommended in conjunction with the water management remedy.

The comments from State and Federal agencies generally supported EPA's preferred alternative. Several agencies indicated a preference for additional source control or treatment remedies, but indicated their willingness to rely on a water management remedy if it could clearly be demonstrated that the other approaches were technically impracticable. Several agencies suggested that additional data should be collected over another wet season. The State requested that EPA re-evaluate the "two-dam" alternative, and indicated an interest in a full evaluation of Rhone-Poulenc's clean water diversion / "dam and treat" approach for Slickrock Creek.

Rhone-Poulenc commented that no further action was necessary at the Site to provide a protective remedy, and that EPA should take no action at this time. Nonetheless, Rhone-Poulenc proposed to implement treatment of contaminated Slickrock Creek base flows. Rhone-Poulenc also submitted comments criticizing specific aspects of the modeling work conducted by EPA in the Water Management FS, EPA's characterization of the IMM area sources and their potential for remediation, EPA's analysis of ancillary environmental impacts associated with an enlargement of SCDD, and EPA's 1994 Fisheries Benefit Analysis. Rhone-Poulenc indicated that it believed there were more cost-effective approaches to reducing the toxic discharges from Slickrock and Boulder Creeks than the ones EPA had identified in its Water Management FS.

In conjunction with its other comments, Rhone-Poulenc submitted an FFS that evaluated several new remedial alternatives. The FFS developed a No Action Alternative, four new alternatives, and presented Rhone-Poulenc's evaluation of EPA's preferred alternative. Although Rhone-Poulenc indicated a belief that no further action was warranted, Rhone-Poulenc proposed to implement treatment of the contaminated Slickrock Creek base flows with additional treatment of identified Boulder Creek sources. Rhone-Poulenc suggested that this alternative should be implemented and evaluated prior to any subsequent actions at the Site. Rhone-Poulenc also developed two alternatives that relied on clean water diversions, and a "dam and treat" approach to control the contaminated discharges from Slickrock Creek, but concluded that these alternatives were not needed at this time and could be implemented later if subsequent monitoring demonstrated their need.

The EPA considered and analyzed in detail comments received from Rhone-Poulenc and other members of the public. The EPA conducted further investigatory and sampling work to develop additional data on the issues identified by Rhone-Poulenc. The EPA's review concluded that there are additional alternatives that may provide for a cost-effective source control and treatment approach for remediation of the Slickrock Creek area sources. On the basis of this review and the technical merit of some of the alternatives developed by Rhone-Poulenc, EPA deferred action on remedy selection from 1994 to 1997 to perform additional studies of these potential source control and treatment alternatives. Detailed responses to the public comments on the 1994 Proposed Plan are included in the Response to Comments document. In addition, the 1996 Water Management FSA includes a discussion of the major comments raised in connection with the 1994 Proposed Plan.

III.3 Public Participation for the 1996 Proposed Plan

In May 1996, EPA issued a revised Proposed Plan to implement a "dam and treat" remedy largely derived from the most effective alternative identified by Rhone-Poulenc in the FFS. The remedy involved diverting upper Slickrock Creek flows (and flows from the unmined side of Slickrock Creek Valley) around the most heavily mining-impacted reach of Slickrock Creek and collecting and treating the reach of Slickrock Creek that is most heavily impacted by past mining activities. The EPA proposed to perform further study of the Boulder Creek area source AMD discharges to support the additional development and evaluation of remedial alternatives for these sources. The public comment period was held for 60 days (EPA extended the public comment period in response to a request from Rhone-Poulenc). On May 23, 1996, EPA held a public meeting in Redding, California, to present EPA's Proposed Plan, to answer questions, and to receive public comments. The EPA also participated in a June 12, 1996, community workshop that was organized by the Shasta Natural Science Association (the IMM TAG grantee) to present the Proposed Plan, answer questions, and invite community participation in the decision making process.

The EPA received detailed written technical comments on the May 1996 Proposed Plan from Rhone-Poulenc and its representatives (EPA considers the comments submitted on behalf of Rhone-Poulenc collectively as the comments of Rhone-Poulenc). The EPA also received written comments from interested State and Federal agencies, but no comments from the general public. Rhone-Poulenc continued to submit comments and information after the close of the public comment period, and EPA continued to accept and consider the information submitted by Rhone-Poulenc.

The EPA carefully reviewed, analyzed, and considered the comments that were received. The EPA has provided detailed responses to the comments on the 1996 Proposed Plan (as well as EPA's 1994 Proposed Plan and other technical studies that were performed during the period from 1994 to 1996, including the 1995 Boulder Creek Remedial Alternatives Study) in the Response to Comments document produced in conjunction with this Record of Decision. The Administrative Record includes a transcript of the public meetings held in connection with the 1994 and 1996 Proposed Plans. The balance of this section contains a brief review of principal comments received in connection with the 1996 Proposed Plan.

III.3.1 Summary of State and Federal Agency Comments on 1996 Proposed Plan

In general, the comments from State and Federal agencies were supportive of EPA's 1996 Proposed Plan for the Slickrock Creek area source AMD discharges. All of the agencies agreed that the proposed Slickrock Creek "dam and treat" alternative was preferable to water management approaches, such as EPA's previous 1994 proposal to enlarge the SCDD. Most agencies agreed with EPA's proposal to perform additional study regarding the Boulder Creek area source AMD discharges. However, Mr. Joel Medlin, on behalf of the U.S. Fish and Wildlife Service (USFWS), commented that he believed that sufficient information is currently available to support the selection of a "dam and treat" remedy for the Boulder Creek area source AMD discharges, and he urged EPA to select such a remedy for these sources now. Mr. Roger Patterson, on behalf of the USBR, also stated a strong preference for the implementation of a "dam and treat" remedy for the Boulder Creek area source AMD discharges, but commented that further study may be warranted.

III.3.2 Summary of Rhone-Poulenc Comments on 1996 Proposed Plan

Rhone-Poulenc agrees with EPA that constructing a dam on Slickrock Creek is more appropriate than enlarging the SCDD. Rhone-Poulenc also agrees that the remedy is technically feasible and that the remedy would effectively control the Slickrock Creek area sources. However, Rhone-Poulenc does not concur with EPA that further remedial action is required, and Rhone-Poulenc urged EPA to conduct further studies before proceeding to take any additional actions at the Site.

Need for Further Action

Rhone-Poulenc commented that no further action is appropriate at this time. Rhone-Poulenc bases its position in large part upon its assumption that a response action is not needed to protect the Sacramento River fishery below Keswick Dam. In particular, Rhone-Poulenc commented that despite the intensity of the storm and resulting spill in January 1995 (and the exceedances of the SBPS that occurred during that spill), no toxicity occurred during the January 1995 spill. This position appears to be based largely on the lack of "observed" toxicity in the Sacramento River and a fish toxicity test conducted by a Rhone-Poulenc consultant with water collected during the January 1995 spill.

The EPA agrees that protecting the fishery and other aquatic resources below Keswick Dam is an important goal of the IMM response action, but EPA does not agree that the current level of response is sufficient to protect the fishery or the other resources below Keswick Dam. The metal concentrations that occurred during the January 1995 storm clearly exceeded levels that are acutely toxic to fish and other exposed resources. The lack of "observed" toxicity is not surprising in light of the general size of the Sacramento River downstream of Keswick Reservoir, the difficulty of visually observing dying or dead fish during periods when the water is turbid, and the life stages of fish most likely to have been acutely affected by the toxic conditions, namely eggs, juveniles, and fry, which are also the most difficult to observe. Similarly, the Rhone-Poulenc toxicity tests do not provide a reliable indicator of whether toxicity occurred below Keswick Dam. Although the toxicity test used water collected during the January 1995 spill, the test water was not representative of conditions observed in the river. For example, the water samples closely approximated the SBPS while much higher concentrations existed throughout much of the spill. Although EPA requested the information, the Rhone-Poulenc consultant did not provide quality assurance test results such as positive control (reference toxicant tests) to validate the health and responsiveness of the trout tested during the studies. These tests are standard protocol for the type of experiments conducted by Rhone-Poulenc. Because of the lack of detailed supporting information on testing procedures, it was not possible to perform a full independent review of the testing or for EPA to rely on the test results. The other available evidence strongly indicates that toxicity occurred during the spill. Rhone-Poulenc's comment also does not take into account the continued release of mass loads of heavy metals to the Sacramento River system, which exposes species to long-term sub-lethal levels of metals.

In addition, EPA disagrees with Rhone-Poulenc's assumption that the fishery below Keswick Dam is the only resource at risk from releases from IMM. Significant environmental degradation continues to exist above Keswick Dam as a result of the continuing releases of significant loads of heavy metals and acidity from IMM. The most obvious degradation exists

upstream of the SCDD, where practically all beneficial uses are impaired, and the creeks are essentially devoid of aquatic life. IMM releases also severely impair conditions in the Spring Creek arm of the Keswick Reservoir. In sum, EPA believes that the available data clearly establish that current releases of hazardous substances from the Site warrant additional response action. More details regarding the risks posed by releases from IMM and the manner in which this response action will address those risks are discussed extensively in other parts of this document and in other parts of the Administrative Record.

Request for Further Delay

Rhone-Poulenc urges EPA to continue to defer selecting a response action based upon the lack of need for immediate action, the need to collect additional data, the possibility that the Sacramento River flows could change due to new legislation, and the possibility that the SBPS will be made less stringent. The EPA does not believe that a further period of evaluation is warranted. Releases from the Site continue to pose a significant threat to the environment. The available evidence clearly demonstrates the technical feasibility, effectiveness, and cost-effectiveness of the proposed Slickrock Creek "dam and treat" remedy. Additional data acquisition is not expected to substantially alter EPA's understanding of the significance of the Slickrock Creek area source AMD discharges or lead to the identification of cost-effective alternate control strategies. A further delay is also unlikely to lead to changes in Sacramento River flows that would cause the response action to be unnecessary. Information available since 1994 in fact indicates that less water could be available in the future due to other important water needs. Finally, a further delay is not likely to lead to a change in the SBPS that would affect the scope of the response action. As explained below, the available science, which is substantial, supports the reasonableness of the existing SBPS, and the EPA is not aware of any planned changes to the SBPS.

Comments on the EPA Water Quality Model

Rhone-Poulenc also submitted extensive comments on the EPA water quality model. The EPA has relied upon the model as one tool to predict the effectiveness of various remedial alternatives with respect to limiting the frequency of SCDD spills and exceedances of the SBPS below Keswick Reservoir. Rhone-Poulenc states that the model relies upon inappropriate assumptions and that the model lacks predictive ability. The EPA has reviewed the Rhone-Poulenc comments regarding the model. The EPA review revealed that Rhone-Poulenc input improper data to the EPA model which, in turn, caused the model to not function properly. When the model is run correctly, the model predicts, with reasonable accuracy, the types of conditions that would cause SCDD spills and exceedances of the SBPS and the types of conditions that would exist in the main stem of the Sacramento River below Keswick Dam during those spills.

In response to Rhone-Poulenc comments regarding specific model assumptions (and other information obtained since May 1996), EPA conducted additional modeling analyses. Among other things, EPA conducted new model runs using water quality and flow data obtained since the 1996 modeling effort, new flow projections from the USBR, recently proposed water quality criteria (the Proposed California Toxics Rule [PCTR]), and additional information regarding the operational efficiency of the SCDD. This additional analysis, which is set forth in the Response to Comments document, confirms the reliability and

reasonableness of the 1996 IMM water quality model (WQM). The model consistently indicates that in the absence of further response actions, exceedances of the SBPS (and the PCTR) will continue to occur on a regular and frequent basis below Keswick Dam.

The EPA also conducted additional analysis of several parameters used in the model. For example, Rhone-Poulenc commented that the EPA model should have relied upon a Spring Creek Reservoir capacity of 5,400 acre-feet rather than 5,016 acre-feet. A review of the Rhone-Poulenc analysis, however, reveals that Rhone-Poulenc did not consider operational constraints that limit the usable capacity of the reservoir to approximately 5,000 acre-feet. Rhone-Poulenc also submitted extensive comments on the precipitation values used in the 1996 model (the precipitation value reflects the extent to which dissolved metals precipitate from solution to form heavy metal particulates as the pH increases due to mixing AMD with less polluted water in Keswick Reservoir). The additional EPA review confirmed the appropriateness of the precipitation values used in the EPA model.

Reliance on SBPS

Rhone-Poulenc commented that the SBPS do not provide a reliable indicator of the need for further remediation because the standards are, according to Rhone-Poulenc, overly conservative and not based on sound science. The EPA does not agree with Rhone-Poulenc that the standards are overly conservative or scientifically unsound. The available information, which is quite substantial, strongly supports the reasonableness of the existing SBPS. Site-specific toxicity tests conducted by the State of California in 1995 and Hagler-Bailly in 1996 indicate that the existing SBPS are appropriate and not overly protective. Those tests are consistent with previous site-specific toxicity tests. To further evaluate the comments submitted by Rhone-Poulenc on the SBPS, EPA sought comment from several other agencies with expertise on this issue, including the CVRWQCB, the National Marine Fisheries Service (NMFS), the NOAA, the USFWS, and the California Department of Fish and Game (CDFG). The comments of these other agencies support EPA's conclusion that the existing standards are a reliable indicator of the need for further response action and that the standards are not overly conservative.

In addition, EPA's Water Management Division recently proposed new statewide water quality criteria for the State of California, the PCTR. The EPA developed these criteria using EPA's most current guidance for developing water quality criteria. Because the new criteria are not yet finalized, the proposed criteria qualify as "To Be Considered Standards" rather than potential ARARs. The PCTR are more stringent than the SBPS with respect to the need for further response action at IMM. These criteria therefore indicate that the SBPS are a reasonable indicator of risk to aquatic resources in the Sacramento River.

Rhone-Poulenc comments that EPA should waive the SBPS on the basis of technical impracticability for areas of Slickrock Creek. The EPA is adopting an interim waiver for compliance with those standards for this interim remedy. The EPA is still evaluating whether a permanent partial waiver of the SBPS is appropriate.

Rhone-Poulenc submitted several legal arguments to support its position that EPA should not adopt the SBPS as ARARs (among others, (1) the standards were adopted specifically to serve as cleanup objectives at the Iron Mountain Site, (2) the SBPS are not of general appli-

cability and have not been consistently applied, and (3) the standards do not properly apply to the tributaries of the Sacramento River such as Spring Creek and Slickrock Creek). As explained more fully in the Response to Comments document, EPA does not agree with Rhone-Poulenc's comments on this issue.

Need for Slickrock Creek Retention Pond

Rhone-Poulenc also objects to the proposed Slickrock Creek remedy on the basis that the retention pond is not necessary to meet the Basin Plan Objectives in the Sacramento River and that, if EPA selected additional response action at the Site, EPA should select baseflow treatment of Slickrock Creek AMD flows. However, baseflow treatment would not meet the requirements of CERCLA. Baseflow treatment is significantly less effective than Alternative SR1 with respect to metal removal. For example, implementing Alternative SR1 in lieu of baseflow treatment would eliminate an additional discharge load of copper of 8,000 to 27,000 pounds per year. This additional copper reduction associated with Alternative SR1 compared to baseflow treatment is roughly equal to 33 percent to 100 percent of the load discharged from all of the regulated dischargers of copper to the Sacramento River system, including the San Francisco Bay and Delta.

Baseflow treatment is also less effective with respect to reducing the frequency and duration of exceedances of the protective SBPS in Keswick Reservoir. While exceedances in Keswick Reservoir are expected to continue under either alternative, Alternative SR1 would be expected to reduce the frequency, duration and degree of the exceedances.

Baseflow treatment is also less effective than Alternative SR1 with respect to protecting the Sacramento River below Keswick Dam. Even after baseflow treatment is implemented, SCDD spills are expected to occur every 4 to 8 years, which is approximately twice the spill frequency expected after implementation of Alternative SR1 (which is expected to reduce spill frequency to once every 8 to 10 years). SCDD spills typically cause SBPS and PCTR exceedances below Keswick Dam lasting from one day to several weeks. If the SCDD were operated to meet the PCTR chronic criteria for copper, the frequency of exceedance would be greater under each approach, but the duration of the exceedances would be significantly longer for the baseflow treatment approach than under Alternative SR1.

Baseflow treatment would also be less effective than Alternative SR1 with respect to restoring the beneficial uses of waterbodies and habitat values in the Spring Creek watershed.

A remedial action that does not address these risks when other technically practicable and implementable alternatives are available to establish more protective conditions, does not meet the requirements of CERCLA for remedy selection (40 C.F.R. § 300.430(f)(1)(i)(A) and (ii)(A) and (B)).

Rhone-Poulenc recently proposed to study the feasibility and effectiveness of installing french drains in the Slickrock Creek Basin and a surface water collector in the Big Seep area in Slickrock Creek to control area sources. EPA had previously considered the appropriateness of alternative groundwater and surface water collection approaches in its technology

screening process for the 1994 and 1996 feasibility studies. Groundwater interception approaches are considered to be inappropriate technologies for addressing Slickrock Creek area sources generally. The groundwater flows are only a minor component of the Slickrock Creek area sources, so a groundwater collection system would not provide a sufficient degree of protection or comply with other CERCLA requirements. EPA's review of data developed since 1996 confirmed the earlier conclusion regarding this issue. Rhone-Poulenc also proposed to study the collection and treatment of a limited amount of surface water, but the approach proposed by Rhone-Poulenc is not technically feasible. The proposed location of the surface-water collection system, the Big Seep area, is highly unstable and in the midst of a massive waste disposal area. Massive amounts of sediments are expected to come down from the debris slide and impact efforts to collect surface runoff without extensive sediment controls. The peak nature of the runoff would be expected to adversely impact efforts to assure treatment of the discharges without adequate flow equalization. The EPA has concluded that the proposed Rhone-Poulenc alternative would not be effective in capturing the majority of the Slickrock Creek area source metal discharges. The EPA also believes that Rhone-Poulenc underestimates the cost of this proposed approach. The surface-water collection system would cost substantially more than Rhone-Poulenc estimates because additional flow equalization facilities and sediment controls are necessary to allow surface-water collection and treatment efforts.

Rhone-Poulenc also commented that EPA did not adequately justify several particular design components of the proposed alternative, including the hematite containment structure, the 5-acre sedimentation pond, a microtunnel between the HDS plant thickener and Spring Creek, and restoration of montane hardwood-conifer habitat. As explained more fully in the Response to Comments document, each of these components is an important part of the selected remedy.

Naturally Occurring Substances

Rhone-Poulenc objects to the remedy on the ground that installation of the Slickrock Creek retention pond will clean up Slickrock Creek to below "natural background levels." In support of its position, Rhone-Poulenc submitted numerous technical reports that purport to estimate metal loads attributable to "natural sources" at Iron Mountain. Rhone Poulenc relies on these reports to conclude that a significant portion of metals loading to Slickrock Creek is attributable to "natural sources."

Rhone-Poulenc's comments on this issue concern the limitation contained in CERCLA Section 104(a)(3)(A). That section provides that "[t]he President shall not provide for a removal or remedial action under [Section 104] in response to a release or threat of release–(A) of a naturally occurring substance in its unaltered form, or altered solely through naturally occurring processes or phenomena, from a location where it is naturally found."

The Slickrock Creek remedy is consistent with EPA's authority under CERCLA. The remedial response is directed at responding to releases altered by mining. As shown in Photo Exhibits 1 and 2, the selected remedy focuses on collecting the releases from the portion of the Slickrock Creek basin that is most heavily disturbed by mining. The area sources of these metals include buried mine portals, mine seeps, waste piles, tailing piles, and buried mineralization exposed by mining through fracturing, lowering of the water table, and removal of

surface materials. Water from upstream of the heavily disturbed mining area and from the unmined side of the valley will be diverted around the disturbed mining area. These diverted flows will not be collected or treated at the IMM treatment plant as part of this remedy.

Despite detailed study of Site conditions and review of the extensive data and analysis submitted by Rhone-Poulenc, EPA has been unable to identify any release of hazardous substances from the Slickrock Creek area sources being addressed in this response action that are unaltered by mining. To the extent that such releases may exist, the releases would be commingled with and indistinguishable from the mining-related sources (and therefore "altered" by those releases). Even if such releases could be identified, EPA is aware of no cost-effective, protective, and reliable alternative that would be capable of isolating the mining-related releases from the "release of a naturally occurring substance in its unaltered form, or altered solely through naturally occurring processes or phenomena, from a location where it is naturally found." The EPA is also not aware of any alternative that would restore the hydrology and geology to its pre-mining condition, which essentially isolated the fresh mineralization from conditions that permit the rapid and extreme release of large loads of highly acidic and metal-laden waters.

The EPA has also reviewed and analyzed the reports submitted by Rhone-Poulenc on this issue. Several of the reports attempt to estimate the pre-mining baseline metal loads. The focus on pre-mining metal concentrations, however, does not address the central issue: whether or not a remedial action is taken in response to a release or threat of release "of a naturally occurring substance in its unaltered form, or altered solely through naturally occurring processes or phenomena, from a location where it is naturally found." Even if it were appropriate to evaluate pre-mining metal loads, the studies submitted by Rhone-Poulenc do not provide an accurate estimate of pre-mining metal discharges. For example, the Rhone-Poulenc reports rely heavily upon water samples collected in the highly disturbed mining area. The reports incorrectly assume that these samples are "undisturbed" by mining and represent "natural background conditions." The reports also rely on other analyses that fail to account for changes induced by mining. As a result, the reports greatly overstate the pre-mining metal levels.

A few of the Rhone-Poulenc reports do try to distinguish between current releases associated with mining versus current "natural" releases, but those reports fail to accurately distinguish between these two categories. For example, the reports assume that all weathering of mineralization is natural. Although weathering of mineralization is a natural process that occurred prior to the time when mining commenced, mining has significantly altered the weathering of mineralization by exposing fresh sulfides to oxygen and water through a host of actions. These changes have greatly increased the rate of oxidation, acidification of water, and release of metals. Such releases are therefore altered by mining and not within the limitation contained in CERCLA Section 104(a)(3)(A).

The EPA also evaluated actual field conditions to assess the validity of the natural background estimates presented by Rhone-Poulenc. These methods include application of the Rhone-Poulenc natural background model to an unmined mineralized area at IMM, evaluation of geologic data regarding the time the mineralization has been exposed to atmos-

pheric conditions, and biologic and genetic studies of areas upstream of the mine-impacted area.

The EPA applied the Rhone-Poulenc natural background model to an unmined mineralized area at IMM. The model predicted copper concentrations ranging from 2,420 to 4,120 ppb and zinc concentrations ranging from 850 to 1450 ppb. When the actual values are measured, however, the concentrations range from 3.7 to 9.4 ppb for copper and 17.3 to 33.8 ppb for zinc. This large degree of error indicates that the Rhone-Poulenc model is not a reliable indicator of pre-mining metal loads.

The EPA also evaluated the Rhone-Poulenc pre-mining metal estimates by examining the available geologic evidence to determine if those rates are geologically possible in light of the time needed to create the gossan deposit at IMM. The pre-mining metal release rates suggested by Rhone-Poulenc indicate that the mineralization has been exposed for less than 50,000 years (based on the current volume of gossan and numerous conservative assumptions that would tend to overstate the period of exposure). Recent paleomagnetic investigations reveal that the gossan has been exposed at least since the last reversal in the earth's magnetic field, which occurred more than 780,000 years ago. This evidence also indicates that the pre-mining release rates predicted by Rhone-Poulenc are gross overstatements.

The Rhone-Poulenc hypothesis regarding pre-mining metal concentrations is also inconsistent with biologic and genetic studies conducted by EPA that indicate that, in the pre-mining period, metal concentrations in Spring Creek, Boulder Creek, and Slickrock Creek were at sufficiently low levels such that each of these surface waters supported a healthy aquatic ecosystem.

In sum, each of the independent methods used by EPA to evaluate pre-mining metal loads indicates that pre-mining metal loads were at most a very small fraction of the current loads being released from IMM.

Cost-Benefit Analysis

Rhone-Poulenc commented that EPA should have conducted and considered a cost-benefit analysis that weighs the costs of the proposed remedial action with any benefits that may derive from the remedial action to the fishery below Keswick Reservoir. The manner in which EPA is to consider costs (and benefits) is set forth in the NCP, and those provisions do not require the type of analysis suggested by Rhone-Poulenc. The NCP is carefully structured so that "protection of human health and the environment" will not be compromised by other selection factors, such as cost. See 55 Fed. Reg. 8726 (1990). Although EPA balances nine selection criteria (including cost) in selecting a remedy, all of the criteria are not given equal weight. Instead, they are divided into three classifications: threshold criteria, balancing criteria, and modifying criteria. Only remedies meeting the threshold criteria (overall protection of human health and the environment and compliance with ARARs) are eligible for consideration in the balancing process by which the remedy is selected. Rhone-Poulenc also incorrectly assumes that protecting the fishery below Keswick Dam is the only benefit of the response action.

The EPA considered cost and cost-effectiveness in conducting its scoping analysis, analyzing alternatives, identifying a preferred alternative, and selecting this response action. Through the FS scoping process, EPA identified technologies and remedial alternatives that could potentially meet the threshold requirements. In the Water Management FS and Water Management FSA, EPA evaluated and considered the cost (including all capital costs and the present worth of all operating and maintenance costs) of those alternatives as one of several balancing criteria. As discussed above, alternatives that do not meet the threshold requirements (such as Slickrock Creek baseflow treatment in the absence of enlarging the Spring Creek Debris Dam) are not eligible for consideration in the balancing process.

In selecting the remedy, EPA considered the cost-effectiveness of the selected remedy, as required by the NCP, by evaluating the overall effectiveness of the proposed Slickrock Creek alternative in proportion to its cost. 40 CFR § 300.430(f)(1)(ii)(D). The EPA determined the overall effectiveness by evaluating the alternative's long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness. *Id.* The overall effectiveness was then compared to cost to evaluate whether the alternative was cost-effective. As set forth below, this analysis indicates that the selected remedy is cost-effective. The EPA also considered cost in evaluating the statutory preference for treatment as a principal element of the response action.

Consistency with Final Remedy

Rhone-Poulenc commented that EPA had failed to ensure consistency of the proposed action with a final remedy for the Site. As set forth elsewhere in this ROD, the Slickrock Creek remedy makes significant progress toward meeting the remedial action objectives of the IMM CERCLA response action. While the response action is likely to continue for some time and other response actions might be developed in the future (such as resource recovery), the interim action is not inconsistent with those types of final remedies. The manner in which this response action fits within the overall Site response action is set forth more fully in the following section.

IV. SCOPE AND ROLE OF THE OPERABLE UNIT WITHIN SITE STRATEGY

IV.1 Role of the IMM Remedial Action

The overall objective of EPA's IMM Superfund cleanup program is to eliminate IMM AMD discharges that are harmful to human health and the environment. Due to the complexity and magnitude of the pollution problem, EPA divided the IMM response action into separate operable units. This approach enabled EPA to address the most serious problems quickly and to achieve a rapid reduction in hazardous substance releases. Remedial steps already implemented at the Site have reduced the heavy metal load release by approximately 80 to 90 percent. Despite the effectiveness of the remedies already implemented, releases from the Site still cause the receiving waters in the Spring Creek watershed to be essentially devoid of aquatic life, the release of significant heavy metal loads to Spring Creek Reservoir, Keswick Reservoir, and the Sacramento River, and exceedances of protective standards in the Sacramento River and Keswick Reservoir on a regular basis. Additional response actions are needed to address these remaining problems. The most significant remaining areas in need of a response action include (1) the area sources in the Slickrock Creek basin (constituting

approximately 60 to 70 percent of the copper and 40 to 50 percent of the zinc and cadmium releases that are currently uncontrolled), (2) the area sources in the Boulder Creek basin (constituting approximately 30 to 40 percent of the copper and 50 to 60 percent of the zinc and cadmium releases that are currently uncontrolled), and (3) the heavy metal sediments associated with past and current releases of IMM AMD (including sediments in Spring Creek and its tributaries, SCR, Keswick Reservoir, the Sacramento River, Flat Creek, and other areas). Studies of these problems are currently underway. These additional studies will also assess the feasibility of further source control and the appropriateness and feasibility of relying on water management options as a component of a final Site remedy, and the need for other response actions. Proceeding in this phased manner enhances the ability of EPA to evaluate the feasibility of restoring portions of the receiving waters in the Spring Creek watershed and other affected water bodies.

IV.2 Scope of the Problem Addressed by the Selected Remedial Action

The specific problem addressed in this remedial action is the release of metals and acidity in the AMD from the area sources in the Slickrock Creek watershed at IMM. The response action is expected to essentially eliminate the discharges from the sources being addressed in this interim action. The collected flows, which will account for approximately 60 to 70 percent of the copper and 40 to 50 percent of the zinc and cadmium releases that are currently uncontrolled, will be treated to remove more than 99 percent of the metals and to neutralize the acidity of the water. The releases addressed by this response action contribute a significant metal load and acidity to the receiving waters. The releases cause or contribute to exceedances of the protective water quality standards, including the SBPS and the proposed California Toxics Rule (PCTR), in Slickrock Creek, Spring Creek, SCR, Keswick Reservoir, and in the Sacramento River below Keswick Dam.

The State of California set the SBPS to assure protective conditions for the Sacramento River fishery and the ecosystem in the upper Sacramento River and its tributaries. The SBPS were reviewed and approved by EPA as a Federal standard under the Clean Water Act. The PCTR are proposed numeric statewide water quality criteria for the State of California. The proposed water quality criteria for aquatic life and human health are designed to establish pollutant levels that would protect aquatic life and human health, respectively. The proposed aquatic life criteria include criteria based on both short-term and 96-hour exposure durations. These two exposure values are intended to represent average pollutant concentrations which will produce water quality generally suited to maintenance of aquatic life. Exceedance of the SBPS (or the PCTR) indicates that aquatic resources are not being adequately protected. The Slickrock Creek area source AMD discharges also result in the formation of toxic sediments in SCAKR and in the main body of Keswick Reservoir and the release of significant volumes of heavy metals in particulate form into the water column of the Sacramento River.

Since this interim remedy is not intended to address all remaining uncontrolled AMD releases, the interim remedy continues to rely on continuing operations of the SCDD to provide for the safe release of the continuing IMM contaminant discharges from the SCR (to the extent technically feasible in light of the current state of the response action at IMM). The interim water management actions are necessary to reduce the likelihood of uncontrolled SCDD spills, reduce the reliance on special releases of CVP waters to dilute IMM AMD-

contaminated surface waters, and meet the SBPS for water quality to the extent feasible. Consistent with the analysis in the Water Management FS, EPA anticipates that the operational targets of the SCDD can be revised to reflect the reduced metal loads from IMM once this remedial action has been implemented. Based upon the current operational procedures used by USBR, these changed operational targets would likely be able to attain the SBPS (and potentially the PCTR) below Keswick Dam under most circumstances, although regular exceedances in areas of Keswick Reservoir and in the Spring Creek watershed are likely to continue without further response action at the Site.

This Record of Decision represents an interim remedy for a portion of the Site, so EPA has considered the need of this remedy to be consistent with future remedial action and the need to reduce significant risks as soon as possible. This interim action addresses the most significant source of currently uncontrolled IMM AMD–the Slickrock Creek area sources entering the reach of Slickrock Creek directly below the most heavily disturbed mining area. The selected remedy is consistent with other potential response actions for the remaining IMM discharges. The remedy is consistent with remediation of existing sediments because the remedy significantly reduces the release of new precipitates into the waters of the state. The remedy is consistent with a response action on Boulder Creek because this remedy does not affect a response action for those sources and takes into account a range of possible actions on Boulder Creek. The remedy is also consistent with reliance on resource recovery once that technology is developed, since the collection systems could potentially be utilized to implement such a system.

V. SITE CHARACTERISTICS

V.1 Contamination

Analytical data collected over several decades indicate that IMM is releasing large volumes of hazardous substances to the environment via AMD discharges. The IMM AMD originating in the Slickrock Creek basin is characterized by its extremely low pH (resulting in a pH of approximately 3 in Slickrock Creek) and very high concentrations of heavy metals (causing current copper concentrations in Slickrock Creek to range from 1,200 to 5,800 ppb during the 1995-96 water year, which is several orders of magnitude more concentrated than the SBPS for copper).

The water quality parameters of concern from a public health exposure perspective are pH, cadmium, copper, and zinc. These parameters are selected because of potential dermal contact effects caused by low pH and potential consumption of AMD (with these three metals being of greatest concern from a water consumption perspective).

The contaminants of concern from the perspective of fisheries (salmon, steelhead trout and other aquatic resources) exposure are pH, cadmium, zinc, copper, and aluminum. These parameters are selected because of their toxicity in the receiving waters to aquatic resources such as salmonids. Those species are sensitive to low pH waters and waters containing metal concentrations ranging from 1 µg/L for cadmium to 100 µg/L for aluminum (copper toxicity levels are in the range of 10 µg/L, and zinc toxicity levels are in the range of 50 µg/L). Recently conducted studies reinforce the sensitivity of aquatic resources (including fish and

algae) to even lower levels of these metals. For comparison, 1 µg/L equals approximately 0.001 mg/L or 1 part per billion (1 ppb).

The contaminants of concern with respect to terrestrial wildlife include arsenic as well as those listed above for aquatic species.

Since October 1994, essentially all AMD discharges from the three largest point sources at IMM have been treated at the IMM treatment plant. Over this period, the IMM treatment plant operations have reduced the uncontrolled IMM discharges of copper, zinc, and cadmium by approximately 80 to 90 percent.

The remaining IMM AMD discharges derive from the widely dispersed area sources. The IMM area sources include waste piles, sidecast spoils, ground disturbed by mining-related activities, discharges from buried workings or partially accessible workings, contaminated soil and debris, seeps, contaminated groundwater, and contaminated sediments in the Slickrock Creek, Boulder Creek, and Spring Creek watersheds at IMM.

The area sources tend to have very complex characteristics that cause the relative significance of the source to vary depending on a host of factors, including storm duration, storm intensity, and antecedent moisture condition. Significant portions of the sources are buried and difficult to locate without an expensive investigation. Some of these buried mine-impacted sources discharge below large landslide areas. Other sources are located on the surface but might discharge metals to groundwater and interflow. Many source discharges can form salts, which in turn become sources of intense metal loading when re-exposed to moisture.

Numerous field investigations have been conducted to characterize these IMM area source discharges and to define the sources related to the discharges. Some specific sources of the AMD discharges have been identified. However, although extensive efforts have been undertaken over the past several years, the majority of the sources of the area source discharges have not been identified. It has been possible to identify an approximate 150-acre area, disturbed by extensive mining efforts, as the area source of essentially all of the Slickrock Creek heavy metal and acidity discharges. See Photo Exhibit 1. Similarly, it has been possible to define an approximate 1,000-foot reach of Boulder Creek adjacent to an area used for extensive mining activities as the area in which 50 to 70 percent of the Boulder Creek area source discharges enter the creek.

Slickrock Creek and Boulder Creek serve as collection points for contaminated groundwater, interflow, and surface water for area sources in the respective watersheds.

The discharges from the area sources are closely associated with heavy rainfall and high run-off storm events. Remedies that are effective at low flow (such as treating baseflows of Slickrock Creek) become significantly less effective as flows increase, which are the time periods when the Site produces the largest releases of hazardous substances.

Releases of arsenic from the several hematite mine processing piles also pose a potential threat to public health and the environment. The piles are actively eroding into state waters and result in arsenic being released into the environment. For example, the arsenic-laden sediments deposited in Spring Creek Reservoir result in exposure of maintenance workers to

levels of arsenic in ambient air that exceed safe levels for workers under OSHA requirements.

Contamination of the Watersheds above SCDD

The receiving waters upstream of the SCDD impacted by releases from IMM are essentially devoid of aquatic life as a result of releases of hazardous substances from the Site (and in the case of Spring Creek, in small part due to the release of metals from the Stowell Mine). The sources of the ongoing contamination include the current AMD releases, contaminated sediments, eroded mine tailings and wastes from past mining activities, and current releases of tailings and mine wastes into surface waters. In contrast, the reaches of these streams upstream of past mining activities support abundant aquatic life.

Contamination Downstream of SCDD

The fishery resources and other sensitive aquatic species in Keswick Reservoir and in the Sacramento River (below Keswick Dam) are the primary natural resources currently at risk because of the continuing uncontrolled IMM heavy metal discharges. The IMM releases contribute to the risks to species in this area by causing the acute exceedance of water quality standards, by exposing aquatic resources to long-term sub-lethal metal levels, and by exposing aquatic resources and benthic organisms to toxic precipitates and heavy metal-laden sediments.

The SCR controls the rate at which IMM AMD is released into Keswick Reservoir and the Sacramento River. The USBR meters the highly polluted IMM AMD into the Sacramento River to permit dilution of the IMM AMD using large volumes of CVP waters. The USBR operates the SCDD in accordance with a 1980 Memorandum of Understanding (MOU), which contains interim operational targets for heavy metals below Keswick Dam. These interim operational targets are intended to provide safe releases of IMM AMD to the extent possible in light of the intense hydrology of the Spring Creek watershed and the very large metal loads released by IMM.

Because of the high pollution loads generated by IMM, water must often be released from SCR at a slow rate to ensure appropriate dilution. This slow release rate can cause the SCR to become full in relatively short periods of time (i.e., several days). Once the capacity of SCR is exceeded, SCR water spills into Keswick Reservoir in an uncontrolled manner (or just prior to a spill, SCR water is otherwise released using emergency release procedures) for periods lasting from a few hours to, more commonly, several days or weeks. Spills from the SCR (and to a slightly lesser extent SCR releases during emergency release procedures) cause exceedances of the SBPS and PCTR in areas of Keswick Reservoir and, in almost all cases, exceedances below Keswick Dam. If the USBR were to operate the SCDD in a manner to achieve more stringent standards below Keswick Dam, the SCR would need to release water more slowly, which in turn would cause the SCR to fill and spill more often. For these reasons, the 1980 MOU recognizes that without extensive controls in place at Iron Mountain, the USBR cannot operate the SCDD in a manner that will be able to ensure compliance with fully protective standards. EPA modeling indicates that in the absence of further remediation, SCDD spills and corresponding exceedances of the SBPS below Keswick Reservoir are expected to occur on average every 3 to 4 years if the SCDD is operated to

achieve the SBPS below Keswick Dam. Operating the SCDD to meet the recently proposed PCTR (below Keswick Dam) would cause the spills to occur every 2 to 3 years on average. Spills would occur even more frequently if the SCR were operated to target compliance with these standards in Keswick Reservoir rather than downstream of Keswick Dam.

The flows in the Sacramento River available at the onset of major early season storm events cannot generally provide adequate dilution of the IMM contaminants at current levels of metals discharges. The EPA has performed an analysis of the hydrologic and water quality factors and has calculated the Sacramento River flow required to ensure the dilution of IMM-contaminated SCR waters to meet water quality standards. During storms in 1995 and 1996, SCR waters, with full treatment of the three major mine discharges, exhibited levels of contamination of 400 to 800 ppb dissolved copper (compared to the SBPS of 5.6 ppb copper at hardness of 40 ppm). The SCR water contains similarly high levels of cadmium and zinc. Storm inflows into the SCR are frequently observed at several hundred to 1,000 cfs. Sacramento River flows are frequently near minimum legal flows during the first storm of the season, or are not generally more than 10,000 cfs.

Events in 1995 provide a good illustration of the types of conditions that present acute risks to the aquatic organisms downstream of the Site. During the January 1995 storms, IMM metal discharges were the source of greater than 90 percent of the Keswick Reservoir metal loads. During that period, a large volume of untreated AMD was released from the Site into the Sacramento River for a period of several weeks. This continuous release of untreated AMD from the Site caused the SBPS to be exceeded in the main stem of the Sacramento River continuously from January 9, 1995, through January 27, 1995. At times during the storm event, copper concentrations were more than twice the levels considered safe under the SBPS and the PCTR. For more information on this issue, see Section 2.3.2.3 of the Water Management Feasibility Study Addendum and reports referenced therein.

During the January 1995 storm event, metal concentrations in the Sacramento River were elevated to levels that are clearly toxic to fish and other aquatic organisms. For example, based on the toxicity testing recently completed by Hagler-Bailly (Hagler-Bailly, 1996), the copper concentrations in the Sacramento River were measured at or near the 96-hour LC50 for rainbow trout fry in the low pH and low alkalinity waters observed during the January 1995 spill. (The LC50 is the concentration of a toxic constituent [in this case, copper] that would result in the mortality of fifty percent of the test organisms [in this case, rainbow trout fry] within a specified time period [in this case, 96 hours]). The LC50 established for rainbow trout in the Hagler-Bailly testing is also applicable with respect to establishing the toxic effects of the elevated January 1995 metal concentrations on the valuable Sacramento River salmon fishery. Additional California RWQCB toxicity testing (RWQCB, 1997) has shown that copper concentrations much lower than the observed conditions of the 1995 spill are toxic to algae, an important element of the Sacramento River ecosystem. For example, RWQCB tests indicate that copper concentrations at or near the current SBPS (5.6 ppb copper at a hardness of 40 mg/l as $CaCO_3$) can be toxic to algae, while concentrations during the January 1995 storm were well above those levels.

EPA's modeling analyses indicate the following:

- Under current conditions, with treatment of the three major IMM sources, SCDD spills of contaminated waters would be expected to occur regularly, even assuming that USBR would always be able to perfectly define the appropriate releases during highly variable storm conditions. Using a more realistic estimate of SCR operations would increase the frequency of the predicted exceedances. Site releases also continue to affect natural resources below the SCDD by discharging large loads of heavy metals which form precipitates that contaminate downstream sediments.

- The two most important factors which currently make it impossible for SCDD to permit dilution of IMM AMD in a manner that maintains the SBPS below Keswick Dam in the Sacramento River are: (1) the storm inflows to the SCR are highly contaminated, and (2) storms that cause these contaminated waters to fill the reservoir within a few days will likely occur every 5 to 10 years. More frequent SCDD spills (on the order of one spill every 3 to 4 years) will occur as a result of other factors such as preceding drought conditions that will limit the flow in the Sacramento River. Spills would occur more frequently if the SCR were operated to target compliance with a more stringent standard or at a point in Keswick Reservoir closer to the SCDD.

- Significant further remediation of the IMM area source discharges, such as reducing dissolved copper concentrations in SCR to 100 ppb or less, is required to ensure that continued operations of SCDD would be able to safely release any continuing uncontrolled IMM discharges to protect the Sacramento River below Keswick Dam. Additional controls would be needed to fully restore the Keswick Reservoir aquatic ecosystem.

V.2 Location of Contamination and Known or Potential Migration Routes

The major mechanism for onsite and offsite transport of contaminants is surface water. The AMD enters Boulder and Slickrock Creeks, and these two creeks discharge into Spring Creek, which flows to the Sacramento River at Keswick Reservoir.

The contaminants of concern can be biologically transported through the aquatic food chain. For example, the initial uptake of contaminants would be by phytoplankton, periphyton, and other aquatic vegetation. These food sources would be ingested by benthic invertebrates and/or zooplankton. The plankton and benthos would be ingested by fish at subsequently higher trophic levels and ultimately consumed by birds, animals, and humans.

The major processes that affect the fate and transport of copper, cadmium, and zinc are coprecipitation with iron hydroxides and precipitation as carbonates. As Spring Creek discharges into the main body of Keswick Reservoir, IMM AMD mixes with water from Keswick Reservoir, which dilutes the SCR waters and increases the pH of those waters. These processes reduce the concentration of dissolved metals but also generate significant volumes of metal precipitates, some of which become river sediment while another portion continues to remain suspended in the water column as the water moves down river. Under current conditions, IMM AMD causes approximately 5 to 15 tons of copper to precipitate into State waters in normal and wet years. In addition, the acidic releases from Iron Mountain introduce cadmium, zinc, and iron precipitants into state waters.

Above the SCDD

The IMM AMD drains to Boulder Creek and Slickrock Creek, which in turn flow into Spring Creek and the SCR. For combined distance of several miles, these receiving waters are essentially devoid of aquatic life as a result of hazardous substance releases from the Site. Releases from the Site also continue to severely impair the habitat of non-aquatic species, particularly amphibians and other species heavily dependent on aquatic resources. Mining-related contaminated sediments also exist in these water bodies, although their current impact is overshadowed by the extreme acidity and metal loads in the surface water.

Below the SCDD

The IMM AMD releases pass through the SCR and Keswick Reservoir and into the main body of the Sacramento River. The USBR operates the SCR in a manner that reduces the concentration of IMM AMD by metering in the SCR water into the Sacramento River flows in Keswick Reservoir. However, even with implementation of the highly effective interim IMM treatment remedial action, the SCR operations continue to be unable to meet either the MOU release schedule for total metals or the SBPS for soluble metals. The inability to maintain the appropriate release schedule and SBPS compliance arises from the large metal loads generated by IMM AMD and the intense hydrology of the Spring Creek watershed. If the SCDD were operated to comply with the PCTR, the frequency and duration of SCDD spills would increase even further because the SCR would have to be released a slower rate to permit the dilution needed to comply with the more stringent criteria. This slower release rate would cause the SCR to fill and spill more often during storm periods.

Other factors also exacerbate the toxicity posed by uncontrolled AMD discharges below the SCDD. The types of storm events that tend to cause uncontrolled spills from the SCDD also tend to create the most difficult periods of SCDD operations and a depression of the hardness in the Sacramento River. As water hardness decreases, metals become more toxic to aquatic resources. Factoring the more difficult operations and the influence of hardness on water quality criteria would therefore tend to compound the difference between the modeled and current SCDD operations. These factors seriously impede USBR's efforts to operate the SCDD in a manner that would be necessary to comply with the SBPS and otherwise maintain fully protective conditions below the SCDD.

The most significant hydrologic conditions related to operating the SCDD in a manner that controls the continuing IMM AMD discharges (or spills) are the combination of low releases from Shasta Lake and high inflows of highly contaminated waters into the SCR. The low releases from Shasta Lake typically occur when Shasta Lake storage is low after one or more years of dry conditions. In such conditions, USBR operations criteria specify that water should be stored for beneficial uses rather than released above certain minimum flows. Shasta Lake storage capacity is approximately 4.55 million acre-feet, with non-usable storage of about 116,000 acre-feet.

When the Sacramento River flow is low, it is very difficult to safely discharge highly contaminated waters from the SCR because, due to the highly contaminated IMM AMD discharges, significant dilution is necessary to meet the water quality criteria below Keswick Dam. The inability to release significant amounts of contaminated water from the SCR is a

critical factor with respect to the problem of high inflows to SCR during storm events. The SCR can fill in a few days during high runoff events. Large storm events with several thousand acre-feet of inflow can cause an uncontrolled spill of contaminated waters within a few days. Prolonged storm events combined with antecedent drought conditions can cause the SCDD to spill for extended periods of time. For example, the SCDD spill in 1992 and 1993 lasted for several weeks and resulted in prolonged exposure of aquatic resources to toxic levels of heavy metals.

All of the six largest storm events since 1955 have occurred in December or January. Historically, most releases from Shasta Lake and Whiskeytown Reservoir in these months total less than 10,000 cfs. Relatively low winter flows particularly at the beginning of the wet season are expected in future years due to current and future water demand and other CVP operational constraints.

The competing demands for fresh water in California for domestic, environmental, agriculture and industrial use are expected to constrain these flows further in future years. Although water availability from one to the next is uncertain, particularly considering the time-period that IMM is expected to continue generated large volumes of hazardous substances, recently acquired information indicates that less Sacramento River water could be available in future water years. For example, the United States Department of Interior, the agency responsible for CVP operations, is currently considering whether to hold more water during the winter months to permit greater flows at other times of the year to protect endangered species. These storage requirements would reduce the available storage capacity of Shasta Lake and the available dilution water for IMM pollution. Other CVP operations being considered by the U.S. Department of Interior would reduce the release of water during high flow periods, which in turn would reduce the water available to dilute IMM AMD.

Other statutes and programs could also affect the flows in the Sacramento River. The available information regarding two such programs, the Central Valley Project Improvement Act (CVPIA) and the Bay-Delta Accord, indicates that those programs are unlikely to have a significant impact on releases from Shasta Lake in December or January, the two months during which the six major storm events since 1955 occurred. Higher release requirements might occur in the spring months through June, but these releases would typically not benefit the IMM response action because SCDD spills typically occur in the early winter months. Additionally, the future diversion of Trinity River flows to the Sacramento River via the Spring Creek Power House is likely to be significantly reduced as the result of efforts to restore the Trinity River ecosystem. The reduced availability of these waters, that have in the past been relied on to dilute the IMM heavy metal releases, would necessitate further remedial action and control of the IMM discharges.

VI. SUMMARY OF SITE RISKS

VI.1 General

The IMM Superfund Site was placed on the National Priorities List on September 8, 1983. The Site was listed because of the impacts of metals-laden AMD discharges on the Sacramento River, which supports a major fishery and which also serves as a source of drinking water and other domestic water supplies for the City of Redding. Throughout much

of its history, the Iron Mountain Site has been associated with water quality degradation and impacts on aquatic resources in nearby drainages. Impacts include numerous fish kills in the upper Sacramento River (at least 39 documented fish kills since 1940), the primary salmon-producing river in California (CDWR, 1985; CDFG, 1990). For more detailed information regarding these risks, see the Public Comment Environmental Endangerment Assessment (May 1992) and the Human Health Risk Assessment (May 1991), as well as other documents in the Administrative Record.

Although EPA Superfund response activities currently control 80 to 90 percent of the IMM AMD releases, hazardous substance releases from the Site continue to pose serious environmental risks. The portions of Boulder Creek, Slickrock Creek, and Spring Creek that receive AMD from Iron Mountain continue to be essentially devoid of aquatic life. During storm periods, the continuing IMM AMD releases constitute the vast majority (more than 90 percent in the January 1995 storm) of metal loading to Keswick Reservoir. Even if the SBPS are met, IMM AMD releases continue to impair water quality through the discharge of large heavy metal loads, a portion of which form precipitates as heavy metal-laden sediments that contaminate the streambed in Keswick Reservoir on an almost continuous basis. In the main stem of the Sacramento River, current IMM AMD releases are expected to cause exceedances of the SBPS and the PCTR on a regular basis. The IMM AMD continues to cause an average of 5 to 15 tons per year of copper precipitates in Keswick Reservoir and the Sacramento River in normal to wet years. For comparison, Iron Mountain currently discharges to State waters an annual average of 80 to 240 pounds of copper per day, which is roughly one to three times the average daily copper discharge of all of the regulated industrial discharges to the entire Sacramento River, San Francisco Bay and Delta.

VI.2 Human Health Risks

Persons who might come into direct contact with or consume concentrated AMD at Iron Mountain could be at risk. Such persons include people working, living, or hiking at the Site. Individuals who enter the Iron Mountain Site are at risk if they have direct contact with or ingest the AMD. The risk of such exposure is currently limited by controlled access to the minesite. The property owner has posted the property to discourage trespassers. The property is located between two heavily used national forests, so direct exposure is clearly possible.

Persons who might come into direct contact with surface water downstream from Iron Mountain include people working, living, hiking, or swimming near the Site. Individuals who come in direct contact with water from the main body of Keswick Reservoir or Sacramento River are not currently at risk.

Persons who might consume surface water downstream from Iron Mountain include people working, living, or hiking near the Site.

Persons who might consume fish taken from the Sacramento River downstream from Iron Mountain include the general population in the upper Sacramento River Valley. Tissue samples from fish inhabiting this area have some of the highest metal levels of anywhere in the State. Individuals who consume fish from the main body of Keswick Reservoir or Sacramento River may currently be at some risk, but the risk has not been quantified.

Children are at somewhat greater risk than adults when considering noncancer toxicity resulting from incidental ingestion of affected creek water downstream from Iron Mountain.

Although an arsenic pathway has not been studied extensively, USBR workers measured arsenic levels in excess of safe worker exposure levels while conducting maintenance on the SCDD. The most likely source of this arsenic is the arsenic-laden hematite piles in the Slickrock Creek watershed, which have been actively eroding into Slickrock Creek for several decades.

VI.3 Environmental Risks

The principal risks posed by the runoff of metals-bearing AMD from Iron Mountain are the associated impacts on aquatic life in the Spring Creek drainage, Keswick Reservoir, and the Sacramento River downstream of Keswick Dam. Among these natural resources, the most important are the fishery resources in the Sacramento River downstream of Keswick Dam. Migratory populations of chinook salmon, steelhead trout, resident trout, and numerous other aquatic and terrestrial species, can be or are affected by AMD from Iron Mountain.

Fishery Resources below SCDD

The salmon and steelhead trout populations have high commercial and/or recreational value to the region. The susceptibility of these populations to contaminants originating from Iron Mountain has been well documented (Wilson, 1982; Finlayson, 1989 and 1995; Hagler-Bailly 1996). One of the chinook salmon runs, the winter-run, is a species listed by the Federal and State Governments as endangered. The steelhead in this region are currently being considered for listing as an endangered species under the federal Endangered Species Act. The spring-run salmon is a candidate species under the State Endangered Species Act.

Pollution from Iron Mountain is considered to be a major factor causing the decline in Sacramento River fishery resources and impeding fishery resource restoration goals. Other major factors contributing to the fishery decline include loss of spawning habitat, predation, habitat degradation, mortality at dams and diversions, overfishing, and natural disasters (such as drought) (Vogel, 1989). Fish migrating into the uppermost reach of the Sacramento River risk being killed by AMD from Iron Mountain; offspring of adult fish spawning in that reach have reduced chances of survival because of the Iron Mountain AMD (Finlayson and Wilson, 1979). There is an indication that AMD from Iron Mountain has reduced the suitability of available spawning grounds for salmon in the uppermost reaches of the Sacramento River and that fish population reductions have occurred following uncontrolled spillage of Iron Mountain AMD (Finlayson, 1979). The greatest decline in salmon-spawning populations has occurred within the uppermost river reach from Balls Ferry upstream to Redding, a distance of approximately 26 river miles (NOAA, 1989). Sub-lethal exposure to toxic metals can also adversely affect exposed species.

Fish counts were initiated at Red Bluff Diversion Dam in the late 1960s. The fish counts document major declines in each of the anadromous salmonid runs. A more extensive data base is available specifically for fall-run salmon. This data base demonstrates that recent levels of spawning escapement to the upper Sacramento River are only about 50 percent of levels observed during the late 1950s. The greatest decline among the salmon runs has occurred for the winter-run, which has been reduced to less than 5 percent of run sizes during

the late 1960s. This serious decline prompted the 1989 listing of this fish as a threatened species by the Federal Government (NMFS, 1989) and an endangered species by the State of California (CDFG, 1989). The Federal Government subsequently reclassified the winter-run as an endangered species.

Currently, the fisheries populations with the greatest potential exposure include the salmonids and steelhead trout present in the Sacramento River below Keswick Dam. The upper Sacramento River chinook salmon runs, steelhead trout run, and resident populations of rainbow trout have life history characteristics that make them vulnerable to potentially adverse effects from AMD originating from IMM. The probability and magnitude of potential exposure depends on the releases of contaminated water from SCDD, the releases of water from Shasta Lake and Whiskeytown Reservoir, and the life stages of fish present within the zone of impact.

For spring- and fall-run chinook salmon, in a worst-case scenario, approximately half of an entire year's spawning production could be at risk from contaminants released from Iron Mountain. The impact of the release depends in large part on the pattern of releases from Shasta Lake and Whiskeytown Reservoir relative to when releases occur from IMM. For example, flood control releases from Shasta Lake could cause most of the year's production to migrate downstream of the affected water quality zone, thereby reducing the AMD's impact.

Under certain circumstances, the endangered winter-run chinook salmon could be at higher risk compared to other runs. That run is most likely to seek cooler water in areas closest to Keswick Dam because of potentially lethal water temperatures in lower reaches of the Sacramento River. Under drought-type conditions, these fish are the most important to future runs because eggs laid further downstream are more likely to be adversely affected by lethal warm water temperatures. However, these same drought conditions are more likely to create conditions (low water flows in the Sacramento River) where AMD from IMM could pose a high risk to juvenile rearing in the uppermost reach of the river. While winter run salmon do not spawn during the period that is most likely to experience an SCDD spill, a spill during the winter run spawning period is not impossible. More importantly, juvenile salmon are generally present in the Sacramento River below Keswick Dam during December and January, when a spill is most likely. Although juvenile salmon are more tolerant of copper and zinc concentrations than eggs and fry, the juvenile salmon could be impacted by IMM contaminant spills during the December and January time period.

The steelhead trout and resident rainbow trout populations that are potentially at risk are not well-defined or understood. However, both the adult and yearling life stages are potentially at risk because both are present in the river when fish kills have historically occurred.

At present, the USBR operates the SCDD pursuant to an MOU. Pursuant to that MOU, USBR operates the SCDD in a manner that (when considering releases of waters from CVP facilities, including Shasta Lake, Whiskeytown Reservoir, and Keswick Dam) will meet operation criteria for control of metal concentrations in the Sacramento River intended to protect aquatic life in the Sacramento River downstream of Keswick Dam, taking into consideration the extreme releases from the Site and provided such operations would not (1)

cause flood control parameters on the Sacramento River to be exceeded, or (2) interfere unreasonably with other project requirements.

The USBR must also operate Shasta Dam to provide electric power, irrigation water, and flood control. The USBR estimated that it would incur significant losses of revenues, depending on the level of protection required in the Sacramento River, if special releases of CVP waters continue to be relied on for purposes of diluting IMM contaminant discharges. There is the potential that USBR's ability to supply adequate dilution water will be further reduced because of conflicting priorities for water use, thereby increasing the potential risk to the aquatic community. It is also important to note that the operational parameters of the 1980 MOU approximate the SBPS below Keswick Dam but do not assure compliance at that location under all circumstances. For example, the 1980 MOU is based on an assumption that 50 percent of the dissolved metals will form precipitates in Keswick Reservoir. More recent and detailed studies by EPA indicate that the precipitation rate is more appropriately estimated at 35 percent under most conditions. Operation of the SCDD in conformance with the 1980 MOU will therefore still result in exceedances of the SBPS (even without taking into account hydrologic events requiring emergency SCDD releases or causing uncontrolled spills).

It is extremely difficult to quantify fish mortality in the Sacramento River as a result of contamination from IMM. This is due to a variety of factors, including the general size of the Sacramento River downstream of Keswick Reservoir and the difficulty of visually observing dying or dead fish during periods when the water is turbid. However, there have been 39 documented fish kills near Redding since 1940, and since the installation of the SCDD in 1963, there have been observations of adult steelhead mortalities near Redding attributable to metal contamination from IMM.

The current mass loading of metals from IMM also exposes aquatic resources to sub-lethal metal levels. For example, metal concentrations in Keswick Reservoir and below Keswick Dam regularly exceed the recently proposed chronic water quality criteria for copper, indicating species in those waters are at risk with respect to chronic exposure to copper. Fish in the area contain some of the highest levels of metals of any fish in the State. In addition, because the SBPS are stated in terms of dissolved and not total metal concentrations, the standards do not protect fish from the effects of exposure to the non-dissolved fraction of total metal concentrations. While the non-dissolved fraction is less toxic than the dissolved fraction, long-term exposure to total metal concentrations is also known to pose risks to exposed organisms.

Environmental Impacts above the SCDD

The environmental effects are even more severe upstream of the SCDD. The waters receiving IMM AMD upstream of the SCDD (Boulder Creek, Slickrock Creek, and Spring Creek) are currently devoid of fish and aquatic invertebrates. These creeks may remain sterile following current remediation activities at Iron Mountain. Whether reaches of those creeks could be restored to a degree that would support aquatic life or other beneficial uses is currently unknown. Implementation of this interim action and the ongoing study of further

action from Boulder Creek area sources will enhance EPA's understanding of the feasibility and appropriateness of taking additional response actions to further address those impacts.

Water Column and Benthic Organisms

Past and current IMM AMD releases also pose a risk to water column and benthic aquatic populations in Keswick Reservoir downstream of Spring Creek. IMM AMD releases have caused and continue to cause the contamination of the water column and stream or reservoir sediments. Below Keswick Dam, contaminant concentrations in the water column occasionally exceed toxic concentrations for sensitive life stages and frequently exceed both EPA and State of California criteria to protect aquatic life, indicating that benthic and water column populations are at risk. The formation of heavy metal precipitates as the AMD releases are diluted poses threats to benthic organisms through smothering as the precipitates settle and through chemical toxicity. Benthic survey information indicates that benthic populations are severely reduced or absent from areas where extensive heavy metal-laden sediments are present in the Spring Creek arm of Keswick Reservoir and in the main body of Keswick Reservoir. The streams above SCDD influenced by IMM are currently essentially devoid of aquatic life.

Terrestrial Wildlife

IMM AMD releases also have the potential to adversely affect onsite terrestrial wildlife. More than 300 species of amphibians, reptiles, birds, and mammals can be expected to occur in the Boulder Creek and Slickrock Creek basins and downstream areas. These species can be directly exposed to AMD. For example, deer can drink from contaminated creeks, lick metals-laden salts along the flume system, or consume contaminated plants or other organisms. AMD has severely impacted the habitat and food sources for species heavily dependent on aquatic resources, such as amphibians. In the absence of hazardous substance contamination, the area could provide habitat for a host of special-status and other species.

VII. DESCRIPTION OF ALTERNATIVES

VII.1 General

Consistent with the NCP, EPA has developed remedial action objectives to assist the Agency in studying remedial alternatives. 40 CFR § 300.430(e)(2)(i). The overall remedial action objective at the Site is to eliminate IMM Site discharges that are harmful to the environment. The EPA has also identified three primary goals for the IMM Superfund remedial action:

1. Comply with the water quality criteria established under the Clean Water Act.

2. Reduce the mass discharge of toxic heavy metals through application of appropriate control technologies.

3. Minimize the need to rely on special releases of California's valuable water resources to ensure compliance with water quality standards in the Sacramento River through special releases of waters to dilute toxic spills of IMM contaminants.

The contaminants of concern identified in the 1986 ROD are acidity and toxic metals, which include copper, cadmium, and zinc. All of these are present in AMD from Slickrock Creek

area sources. Arsenic is an additional contaminant of concern that has been identified with respect to the large hematite pile that is actively eroding into Slickrock Creek and downstream areas. The arsenic in the hematite pile exceeds the total threshold limit criteria (TTLC) established by the State of California. The high arsenic concentrations that are present in this waste pile pose a threat to human health and the environment.

VII.2 Technology Screening Evaluation

The technology screening phase of the feasibility study consists of a two-step process. The first step involves identifying general response actions that could potentially meet the remedial action objectives for the sources being addressed. The second step involves analyzing and comparing technologies and process options that EPA has determined are appropriate for consideration.

The EPA determined that the Site conditions restrict the number of alternatives to four general types of response actions:

1. No-Action—No further actions would be implemented as part of the EPA Superfund cleanup action at the Site.

2. Source Control Response Actions—Prevent AMD formation through isolation of water and/or air from the sulfide rock.

3. Treatment Response Actions—Collect and treat the AMD, dispose of the treatment residuals (sludge), and discharge the treated water.

4. Water Management Response Actions—These options include surface-water diversions of clean water flows and construction of dams to contain the contaminated flows until they can be treated or safely released.

The EPA then refined the range of alternatives within each category by first evaluating whether the alternative was technically implementable at this Site. If an option was not technically implementable, the option was eliminated from further consideration. The EPA then evaluated the remaining options more closely to determine the options and technologies to be developed into remedial alternatives. This selection is made by comparing the options on the basis of implementability and effectiveness, with implementability being the more important criterion during the screening process.

Following is a brief summary of the screening evaluation.

VII.2.1 No Further Action

In accordance with the NCP, EPA evaluated the No Further Action alternative in detail.

VII.2.2 Source Control Response Actions

Source control response actions involve source-specific responses for individual AMD sources. Potential source control response actions include groundwater control, capping, surface controls, removal of waste piles and sediments, and resource recovery. For purposes of clarity, this document refers separately to source controls that prevent AMD formation and

general collect and treat technologies. Certain other documents refer to these non-water management technologies as "source control" remedies.

An EPA review of the types of sources being addressed in Slickrock Creek indicated that a source-specific approach would be difficult to implement, and even if feasible, would likely be less cost-effective than a general collect and treat approach. In general, the Slickrock Creek area sources are difficult to identify and characterize. The sources are spread throughout the Slickrock Creek basin in the vicinity of areas affected by intense mining activity. Many of the sources, such as the mine workings and mineralization exposed through changes in hydrology, are belowground and/or buried below the large debris slide. Despite Rhone-Poulenc's best efforts to locate buried mine portals during the past 2 or 3 years, it has not been able to locate buried mine workings with AMD. The presence of millions of cubic yards of mine overburden and other materials over the mine workings severely impedes the identification of these sources. Even if the workings are identified, one would need to develop a reliable strategy for responding to releases associated with that source.

With respect to some of the more significant area sources that are readily identifiable, the most effective remedial strategy appears to involve a general collect and treat approach. For example, the large debris slide is a source of mining-related hazardous substance releases. The debris slide contains millions of cubic yards of materials so that excavation and consolidation would be very difficult and prohibitively costly to implement. In addition, removal or consolidation of the debris slide would likely increase the exposure of the underlying sulfides to oxygen and water, thereby increasing the release of AMD. Source control of disturbed mineralization would likely be even more difficult because the areas are widespread and not easily accessible. These factors suggest that general collect and treat approaches would be more effective and cost-effective than source-specific type approaches.

Source Control by Groundwater Control

Source control by groundwater control involves reducing or eliminating groundwater contact with sulfide rock by blocking lateral groundwater flow with a barrier or intercepting the flow with an active well-dewatering system. Since this technique is not effective in broken ground located above and around mine workings and around waste piles prevalent in the target area, the approach cannot be used as a primary response action for these sources. The EPA also reviewed and rejected as not practical or effective the use of pressure grouting to control seep flow.

Source Control by Capping

Capping involves placing a cap in a manner that reduces the inflow of fresh water to the acid-forming zones. The feasibility of this approach depends on the feasibility of placing an impervious cover above the source, the practicality of maintaining the cover during the life of the project, and the proportion of water actually diverted from the sites of reaction. While this strategy is implementable and could potentially be used with respect to a few sources, the approach is not a practical means to control Slickrock Creek area sources generally due to the very large area over which AMD-forming reactions appear to be occurring, the steep terrain in those areas, and the potential for landslides and the continued movement of the waste materials and debris to be capped.

Source Control by Surface Controls

Source control by surface drainage controls involves routing surface water away from waste piles and disturbed areas through the use of grading and diversions. While this strategy is implementable and could potentially be used with respect to a few sources, the approach is not a practical means to control Slickrock Creek area sources generally. The Slickrock Creek area sources cover an area of approximately 150 acres. Extensive surface water diversions would be required to prevent surface water from entering this source area. However, these surface controls would not prevent rainfall from falling directly onto these area sources resulting in AMD formation and discharge. The approach is unlikely to obviate the need for a general collection approach. Surface water controls may be useful in controlling specific areas in future actions at IMM.

Source Control by Removal of Waste Piles

Excavation and consolidation of waste piles, contaminated soils, debris, and/or sediments, is considered to be impracticable for the Slickrock Creek area sources in general. The amount of material present in the debris slide and other contaminated areas is too extensive to make this approach feasible for general remediation of the Slickrock Creek area sources. The steep and difficult terrain would also make this approach difficult to implement throughout the basin. In addition, removal of the debris slide might increase the exposure of sulfides and therefore exacerbate the release of hazardous substances. The approach is also unlikely to be cost-effective relative to a general collect and treat approach. However, removal of specific waste piles may be appropriate in a final remedy for the Site. Also, removal of contaminated sediments, although very difficult, may be necessary as part of the Site remedy to achieve ARARs compliance.

Source Control by Resource Recovery for Waste Piles

EPA also evaluated several resource recovery treatment options that could be used to recover certain metals from some of the waste piles. These options include flotation (a historic treatment method for ore) or soil washing (such as acid leaching, which has been also used to treat ore). The removal efficiencies of these processes are expected to be low because the in situ metals concentration in piles is relatively low, and the metals are likely to be present primarily as insoluble sulfides. The implementability and effectiveness of these treatment options cannot be currently evaluated, but the available information does not establish that this current technology would permit this approach to be cost-effective or implementable at this time. Laboratory or bench-scale testing is required to provide sufficient information to conduct more detailed assessments. Because of the lack of demonstrated effectiveness, EPA dropped these alternatives from further consideration in the analysis.

VII.2.3 Collection of Seeps and Surface Water

The EPA also considered the feasibility of collecting and treating seeps using groundwater extraction systems, such as wells or drains. This approach could be implemented in combination with treatment of portal discharges at the IMM HDS treatment plant currently in operation. There are technical and cost limitations concerning the treatment of seeps because of the expected small flow rates and metals loads from these sources and because access to some of the seeps will be difficult. The EPA eliminated this approach from further consid-

eration in the FSA because of its limited effectiveness for the dispersed Slickrock Creek AMD discharges.

The EPA considered the feasibility of collecting and treating contaminated tributary flows and treating those flows at the existing IMM HDS treatment plant. There are technical and cost limitations concerning the collection and treatment of contaminated surface waters because of the large volumes of contaminated runoff associated with storm events that may require treatment and because of the dilute nature of these flows. The presence of the existing HDS neutralization treatment plant and its ongoing operations significantly enhances the implementability and cost-effectiveness of this approach. Collection systems for surface-water collection and treatment approaches would include surface-water diversions to ensure collection of contaminated surface waters from remote contaminated areas and retention basins and to regulate their discharge to a treatment plant. The surface-water collection technologies were retained for further study in the FSA.

VII.2.4 Treatment Response Actions

Treatment was considered both as a stand-alone response action and in combination with other technologies to form combined alternatives. The HDS neutralization/precipitation of AMD is considered the primary treatment option on the basis of past studies. The HDS treatment process was selected in ROD2 and ROD3 for IMM. The reliance on the HDS process is expected to provide significant benefit for the treatment of the dilute Slickrock Creek area source AMD discharges. The full-scale IMM HDS treatment plant became operational at IMM in January 1997.

In-stream treatment, cementation, membrane processes, ion exchange, and passive treatment were dropped because of their expected limited effectiveness or because they were not implementable. Mechanical evaporation, liquid-liquid extraction, and biological treatment were retained for further consideration as secondary treatment options.

Disposal options were studied because all primary treatment options generate a sludge that requires disposal. RCRA landfills were not considered because past IMM RODs concluded that a non-RCRA sludge disposal option is the preferred technology. A non-RCRA landfill is currently in operation at IMM at Brick Flat Pit. Treatment of the Slickrock Creek area source AMD discharges is not expected to change the nature of the treatment sludges or disposal requirements. The EPA has concluded that the non-RCRA sludge disposal technology would be effective, implementable, and cost-effective. Sequential modifications could be made to the Brick Flat Pit sludge disposal facility to enable sufficient storage capacity for sludge disposal for 50, 100, or several hundred years, depending on the volume of AMD treated and the characteristics of the sludge produced. The Brick Flat Pit non-RCRA sludge disposal option was retained for further consideration.

The additional treatment plant effluent resulting from treatment of the Slickrock Creek area source discharges could be discharged either onsite to Spring Creek, Boulder Creek, or Slickrock Creek, or offsite to the Sacramento River. The IMM treatment plant currently discharges to Spring Creek by a pipeline. The larger volumes of effluent will require the construction of additional facilities such as a gravity tunnel or an additional pipeline. The EPA dropped from consideration an alternative involving piping the discharge to the Sacramento

River because the option would be more costly to implement but did not provide any additional benefit over the Spring Creek discharge option. The EPA retained discharge of the treatment plant effluent to Spring Creek.

VII.2.5 Water Management Response Actions

Water management response actions include surface-water diversions of clean water flows and construction of dams to contain the contaminated flows until they can be treated or safely released. These response actions could be implemented to meet several distinct project objectives: (1) divert clean waters away from contaminated areas to reduce AMD-forming reactions; (2) increase the effectiveness of treatment approaches by diverting clean flows away from the collection basin; and (3) provide capability to manage releases of contaminants to surface waters that cannot be feasibly controlled to ensure protection of human health and the environment.

Surface Diversion

The intent of surface-water diversions for water management remedial approaches is to divert less contaminated surface-water flows around AMD containment basins. The diversion of less contaminated waters can be accomplished by a variety of methods. Clean-water diversions were retained for further consideration as they can be designed to perform effectively in combination with other technologies, and offer the opportunity to develop more cost-effective remedial approaches.

Containment Dams

Containment dams create reservoirs (basins) for storage of contaminated waters until the water can be safely released or treated.

The SCDD could be enlarged to provide additional storage capacity for the contaminated Spring Creek watershed inflows. The existing SCDD establishes a 5,016-acre-foot reservoir to contain IMM-contaminated waters. Although the existing SCR provides some protection to the environment, it is undersized to allow for full protection in the absence of additional remedial alternatives beyond the No-Action Alternative. An enlarged reservoir would be needed for storage of the IMM-contaminated waters to permit the water to be released in accordance with protective water quality criteria.

Under an alternate approach, new dams could be built in Boulder Creek, Slickrock Creek, and/or Spring Creek above SCR to establish new reservoirs. These alternate reservoirs could be relied on as storage reservoirs in conjunction with the existing SCR.

Under a third approach, potential onsite containment basins would be relied on in combination with treatment remedial action components to ensure treatment of the contaminated waters contained by the dams. Studies indicate that control and treatment of the Slickrock Creek area source AMD discharges are consistent with viable remedial strategies for the Site that could be effective and cost-effective.

Containment dams were retained for further consideration as they can be designed to perform effectively in combination with other technologies, and offer the opportunity to develop more cost-effective remedial approaches.

Reliance on CVP Dilution Water

The current interim remedy relies upon water management options because the SCR is used to contain IMM AMD releases until they can be safely discharged, taking into account the dilution available in the Sacramento River flows and the limitations imposed by intense hydrologic conditions as well as the intense pollution loading from IMM. Additional source control programs at IMM will reduce, but may not eliminate, the heavy metal discharges. Special releases of Sacramento River waters may be required in the future to ensure adequate dilution of the IMM discharges. The manner in which dilution water may be acquired and provided to ensure protection of the Sacramento River fishery and aquatic ecosystem is described in EPA's June 1994 Water Management FS. Potential IMM remedial strategies that rely on special releases of dilution water as part of a final IMM remedy were taken into consideration in evaluating the appropriateness of the water management actions considered. The purchase of dilution water was retained for further consideration as a component of future remedial actions. Purchase of dilution water may provide an effective and cost-effective approach to providing a fully protective remedy for human health and the environment below Keswick Reservoir.

VII.2.6 Summary of Screening Analysis

Through this screening process, EPA determined that the following technologies and options are potentially suitable for assembly into alternatives for the Slickrock Creek area source AMD discharges:

- No further action
- Collection of surface water for treatment
- Physical-chemical treatment using the lime/HDS neutralization/precipitation process as a primary treatment process
- Physical-chemical treatment using the mechanical evaporation/crystallization process as a secondary treatment process following the lime/HDS process
- Landfill disposal of treatment sludge in a non-RCRA landfill
- Discharge of treated water to surface waters using an outfall
- Surface water diversions of less contaminated water using pipelines, open channels, dams, drop inlets, or ditches
- Containment basins in Slickrock Creek to temporarily store contaminated waters until water can be safely released or treated

VII.3 Alternatives

In June 1994, EPA published a Water Management FS, which examined potential remedial alternatives that could control, treat, or manage the safe release of continued uncontrolled contaminant discharges from the numerous and widely dispersed area sources in the Boulder Creek and Slickrock Creek watersheds at IMM. In the Water Management FS, EPA devel-

oped five alternatives for detailed evaluation that included a range of approaches relying on source control, collection and treatment, and water management technologies. Although some area sources could be readily identified and remediated (such as waste piles), a large proportion of the area source discharge was, in general, difficult to identify and characterize. As a result, the remedial alternatives that were developed and evaluated in the Water Management FS relied more heavily on collection and treatment approaches and water management approaches rather than on source control approaches. The five original detailed remedial alternatives for a sitewide remedy for the IMM area source AMD discharges were labeled WM0, WM1, WM2, WM3, and WM4. The EPA relied on the Water Management FS to develop its 1994 Proposed Plan, which identified a variation of Alternative WM3 as the preferred alternative. The EPA published this Proposed Plan in June 1994 and requested public comment on the proposed plan and related documents.

As a result of comments from the public and further study by EPA, EPA prepared the 1996 Water Management FSA, which presented a revised analysis of the No-Action Alternative, WM0, and developed and evaluated a new remedial alternative, SR1, which focused on a Slickrock Creek source control and treatment remedy.

Each of the alternatives is summarized below.

Alternative WM0

The No Further Action Alternative was evaluated as required by the NCP at 40 CFR § 300.430(e)(6) to determine the risks that would be posed to human health and the environment if no further actions were taken at IMM to address the continuing AMD discharges. The No Further Action Alternative is relied on as a baseline alternative against which other alternatives are judged. The No Further Action Alternative would include provisions for continued limited monitoring, operation and maintenance of the IMM treatment plant facilities, operation and maintenance of the ancillary facilities and other projects constructed pursuant to ROD1, ROD2, and ROD3 for the IMM Site, and continued operation of SCDD in accordance with the existing 1980 Memorandum of Understanding.

The EPA has determined that this alternative would not meet remedial action objectives.

Alternative WM1

Alternative WM1 relies on the increased water management capability provided by the enlargement of the SCR to 15,000 acre-feet. This approach would involve the construction of a 75-foot raise to the SCDD. The USBR would coordinate operations of the SCR with its CVP operations. Dilution water would not be purchased during the expected infrequent spill events.

The EPA's analysis concluded that the increased storage capacity for the contaminated IMM discharges and Spring Creek watershed runoff would reduce SCDD contaminant spills to one to three per century and provide significantly increased protection to the Sacramento River. The cost of this alternative is estimated to be $75.2 million.

Alternative WM2

Alternative WM2 relies on the increased water management capability provided by the enlargement of the SCR to 15,000 acre-feet. Additionally, under this alternative, the contaminated base flow of Slickrock Creek would be collected and treated at the existing IMM treatment plant. In addition to the 75-foot raise to SCDD, this approach involves the construction of a small dam in Slickrock Creek, a pipeline, and only limited modifications to the IMM treatment plant.

The EPA's analysis concluded that the increased storage capacity, coupled with treatment of the contaminated Slickrock Creek base flows, would reduce SCDD contaminant spills to once per century, reduce the currently uncontrolled site discharges by 30 to 35 percent (copper) and 20 to 25 percent (zinc and cadmium) by treating up to 50 percent of the Slickrock Creek area source AMD, and provide significantly increased protection to the Sacramento River. The cost of this alternative is estimated to be $79.4 million.

Alternative WM3

Alternative WM3 relies on the increased water management capability provided by the enlargement of the SCR to 15,000 acre-feet, the collection and treatment of the contaminated base flow of Slickrock Creek, and the purchase of dilution water during rare SCDD spill events. In addition to the 75-foot raise to SCDD, this approach involves the construction of a small dam in Slickrock Creek, a pipeline, and only limited modifications to the IMM treatment plant.

The EPA's analysis concluded that this alternative would provide similar metals reductions to Alternative WM2. The ability to purchase limited amounts of dilution water during spills would allow for the mitigation of the expected rare SCDD spill event and provide for increased protectiveness over Alternative WM2. The cost of this alternative is estimated to be $89.1 million.

Alternative WM4

Alternative WM4 relies on the collection and treatment of all contaminated flows in Boulder Creek and Slickrock Creek up to a 100-year storm event. This approach involves the construction of two small dams, clean water diversions, pipelines, and an expanded treatment plant. The alternative could potentially restore some of the beneficial uses upstream of the SCDD.

The EPA's analysis concluded that this alternative would provide the most protection to the Sacramento River and the resources upstream of the SCDD as well as the greatest reduction in the Site metals discharges. The cost of this alternative is estimated to be $129.5 million.

Alternative SR1

Alternative SR1 incorporates a retention dam within the Slickrock Creek drainage, a clean-water diversion system, and upgrades to the pipeline and treatment plant. Alternative SR1 relies on the collection and treatment of the AMD-contaminated surface-water discharges that are from the area sources in the Slickrock Creek watershed at IMM. The remedy, as finally designed and implemented, may rely to some extent on source control of specific sources and

on water management technologies (such as diverting nearby downstream sources into the containment pond area) to ensure collection of the contaminated surface flows as well as to minimize the amount of water that could become contaminated by the area source discharges and require treatment.

The Slickrock Creek retention dam and pond would be located within the Slickrock Creek drainage of Iron Mountain directly below the most heavily disturbed mining area in the watershed. Inflows include surface-water runoff from the highly disturbed mining areas, flows from the former open pit mine and current sludge disposal Site, flows from Slickrock Creek, and flows from the Old/No. 8 Mine Seep, and flows from the hematite pile area. The dam would be located approximately 200 feet upstream of the hematite pile (with the exact location to be determined during design). A conceptual depiction of the remedy is shown in Photo Exhibit 2. A dam at this location would collect drainage from an area of approximately 546 acres; however, 387 acres of the drainage area would be intercepted by a clean-water diversion (modified as necessary) and discharged into Slickrock Creek below the proposed retention dam. An additional 44 acres of drainage above Brick Flat Pit is also currently collected and diverted into Slickrock Creek below the proposed dam. The potential AMD-generating area of the Slickrock Creek drainage is therefore approximately 115 acres. The pond developed behind the dam will temporarily store AMD before it is conveyed by pipeline to the HDS treatment plant onsite. The retention dam will be sized to contain 100-year storms, which would require a reservoir capacity of at least 170 acre-feet. The exact size and capacity of the reservoir would be determined during the design phase, but preliminary information indicates that the retention dam would be approximately 105 feet high (75 feet above the existing streambed). This alternative also includes a retaining structure to prevent erosion of the hematite pile, consistent with California mining waste requirements. The cost of this alternative is estimated to be $ 21.2 million.

A bullet summary of the components of Alternative SR1 is presented below:

- Construct a retention dam and necessary surface water diversion facilities to ensure the collection and storage of contaminated surface runoff, interflow, and groundwater in the Slickrock Creek watershed at IMM.

- Construct facilities to provide controlled release of contaminated waters from the retention dam to the AMD conveyance pipeline to the IMM HDS/ASM lime neutralization treatment plant.

- Construct facilities to divert relatively uncontaminated surface water from the area upstream from the highly disturbed mining area of the Slickrock Creek basin and divert that water around the Slickrock Creek retention reservoir. The diversion shall also divert around the retention reservoir the water from the unmined side of the Slickrock Creek watershed.

- Take appropriate steps (including consideration of emergency failure scenarios) to integrate into the operation of the reservoir the collection and conveyance of the Old/No. 8 Mine Seep AMD to the IMM HDS/ASM lime neutralization treatment plant.

- Construct a hematite erosion control structure consistent with California mining waste requirements.

- Construct one or more sedimentation basin(s) or other EPA approved control structures in the Slickrock Creek watershed to minimize sedimentation of the Slickrock Creek retention reservoir and to ensure proper functioning of the controlled release facilities.

- Upgrade the hydraulic capacity of the existing pipeline (or if necessary construct a new pipeline) from Slickrock Creek to the Boulder Creek crossing as required to ensure adequate reliable capacity to convey Slickrock Creek and Old/No. 8 Mine Seep AMD.

- Construct an additional pipeline to reliably convey Slickrock Creek and Old/No. 8 Mine Seep AMD from the Boulder Creek Crossing to the IMM HDS/ASM lime neutralization treatment plant.

- Modify the IMM HDS/ASM lime neutralization treatment plant to ensure proper treatment, using the HDS/ASM treatment process, of the Slickrock Creek area source AMD discharges in conjunction with AMD flows collected pursuant to other Records of Decision.

- Construct a tunnel to provide for gravity discharge of the high volumes of effluent from the IMM HDS/ASM treatment plant to Spring Creek below the Upper Spring Creek diversion to Flat Creek.

- Construct facilities to assure collection of significant identified sources (including but not limited to seeps from Brick Flat Pit and the hematite piles) and convey those releases to the Slickrock Creek Retention Reservoir.

- Perform long-term operations and maintenance (O&M) of all components.

The alternatives are presented in tabular form below in Table 1.

TABLE 1
Summary of Descriptions
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Components
Alternative WM0–No Further Action.	Maintain partial cap, Slickrock Creek diversion, and Upper Spring Creek diversion.
	Continue treatment of AMD discharge from Richmond and Lawson portals and Old/No. 8 Mine Seep.
	Assumes that USBR will continue to operate the SCR in accordance with the 1980 MOU criteria.
	Continue water monitoring.

TABLE 1
Summary of Descriptions
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Components
Alternative WM1–Enlarge SCR to 15,000 acre-feet and dilute uncontrolled spill water, if dilution water is available.	Contains same elements as Alternative WM0 with the exception of the SCR operations criteria. Enlarge SCR to a capacity of 15,000 acre-feet. Operate the SCR in compliance with the SBPS. Provide special dilution releases for uncontrolled SCDD spills, only to the extent they can be made available.
Alternative WM2–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water, if dilution water is available.	Contains same elements as Alternative WM1, including the enlargement of the SCR to a capacity of 15,000 acre-feet. Collect and treat 750-gpm base flow from Slickrock Creek in HDS treatment facility. Operate the SCR in compliance with the SBPS. Provide special dilution releases for uncontrolled SCDD spills, only to the extent they can be made available.
Alternative WM3–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water with purchased dilution water.	Contains same elements as Alternative WM2, including the enlargement of the SCR to a capacity of 15,000 acre-feet, and the collection and treatment of 750-gpm base flow from Slickrock Creek in HDS treatment facility. Operate the SCR in compliance with the SBPS. Provide special dilution releases for uncontrolled SCDD spills with a limited amount of purchased dilution water.
Alternative WM4–Rely on the existing SCDD for backup for plant failures, build two alternative dams (one in Slickrock Creek and one in Boulder Creek), build clean-water diversions, and collect and treat all contaminated water.	Contains same elements as Alternative WM0 with the exception of the SCR operations criteria. Build two alternative dams on Slickrock Creek and Boulder Creek. Build clean-water diversions. Collect and treat all contaminated runoff. Existing SCDD would be relied upon only as a backup in case of a failure of the treatment system.
Alternative SR1–Construct a dam in Slickrock Creek and clean-water diversions, collect and treat all contaminated Slickrock Creek runoff, and build a retaining structure for the hematite pile.	Contains same elements as Alternative WM0 with the exception of the SCR operations criteria. Build clean-water diversions and a retention dam in Slickrock Creek. Upgrade the capacity in conveyance pipelines and the IMM HDS treatment plant. Build a tunnel to discharge treated AMD into Spring Creek. Build a control structure to prevent hematite erosion into Slickrock Creek. Provide controlled release of Slickrock Creek AMD from retention dam and treat at HDS plant. Operate the SCR in compliance with the SBPS.

TABLE 1
Summary of Descriptions
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Components
	Provide special dilution releases for uncontrolled SCDD spills, only to the extent they can be made available. Alternative SR1 can later be combined with an appropriate area source remedial alternative for Boulder Creek (such as those developed and evaluated in EPA's Boulder Creek Remedial Alternative Study).

VIII. ALTERNATIVE COMPARISONS

The detailed analysis of alternatives consists of an assessment of individual alternatives against nine evaluation criteria identified in the NCP and a comparative analysis that focuses on the relative performance of each alternative against those criteria. The resulting strengths and weaknesses of the alternatives are weighed to identify the alternative providing the best balance among the nine criteria. The nine evaluation criteria specified by the NCP in 40 CFR § 300.430(e)(9) are: (1) overall protection of human health and the environment; (2) compliance with ARARs; (3) reduction of toxicity, mobility, or volume through treatment; (4) long-term effectiveness and permanence; (5) short-term effectiveness; (6) implementability; (7) cost; (8) State acceptance; and (9) community acceptance. Assessment of two of the nine criteria, State acceptance and community acceptance, is not completed until after comments on the Proposed Plan are received.

Other than Alternative SR1 which addresses only remediation of area sources in the most heavily impacted reach of Slickrock Creek and the No-Action Alternative, each alternative addresses the remediation of AMD discharges from the entire IMM Site by addressing capture of both Slickrock and Boulder Creeks. Alternative SR1 does not address Boulder Creek area sources because further studies are underway to define the best way to remediate those sources. As set forth in EPA's August 1995 Boulder Creek Remedial Alternatives Study, EPA has determined that a range of alternatives is available for the Boulder Creek area source AMD discharges so that Alternative SR1, in combination with an appropriate Boulder Creek area source remedy, provides protection equivalent to Alternative WM4 and superior to Alternatives WM0, WM1, WM2, and WM3.

The consideration of an alternative that addresses Slickrock Creek without requiring completion of the studies for Boulder Creek is consistent with 40 CFR § 300.430(a)(ii)(A), which identifies as a program management principle that "[s]ites should generally be remediated in operable units when necessary or appropriate to achieve significant risk reduction quickly, when phased analysis and response is necessary or appropriate given the size and complexity of the Site, or to expedite the completion of total Site cleanup."

VIII.1 Criterion 1—Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Protection of Human Health

Concentrated acidic waters with high levels of heavy metals are harmful to humans. The concentrated IMM AMD is mainly limited to remote and uninhabited areas, such as Spring Creek and its tributaries. Controls are currently in place to restrict access to those areas, but human consumption of these flows is not impossible. Alternatives WM4 and SR1 provide the potential for some improvement (compared to the other alternatives) in protection of human health because in varying degrees these alternatives could reduce metal concentrations in lower Spring Creek and its tributaries. Overall, however, this improvement is considered marginal in light of the limited access to those water bodies.

The relative protection of human health associated with dilute AMD releases below the SCDD is not a major issue for evaluating either the No-Action Alternative or the action alternatives. Although the IMM AMD from the Slickrock Creek area sources discharges into the Sacramento River, which is a source of drinking water, the nearest point of withdrawal from the Sacramento River for domestic or municipal water use is downstream from Keswick Dam. Even under the No-Action Alternative, EPA anticipates that the Safe Drinking Water Standards will be met at that point. Further, the RWQCB coordinates with the City of Redding during SCDD spill and emergency release periods so that groundwater can be used if appropriate, thereby providing additional protection to human health. The remedies that reduce metal loads to state waters would be expected to reduce human health risks associated with consumption of fish contaminated with high levels of heavy metals from IMM, although the risks associated with such consumption has not been quantified.

Remedy SR1 would reduce exposure to arsenic associated with the hematite pile, so the remedy would protect human health with respect to future releases from the hematite piles. Exposures resulting from past releases from the hematite pile are not addressed by this remedy.

Protection of the Environment

The level of environmental protection of the alternatives varies. The No-Action Alternative, WM0, provides only a continuation of the controls now in place (the partial cap, the Spring Creek and Slickrock Creek diversions, and treatment of the AMD discharges from the Richmond/Lawson portals and Old Mine/No. 8 Mine Seep). The No-Action Alternative is not considered to be protective. Present impacts to the environment would remain unchanged or would become more severe over time. The current water quality degradation and associated impacts would continue in Slickrock Creek, Boulder Creek, Spring Creek, SCR, Keswick Reservoir, and the Sacramento River. IMM AMD would continue to constitute the dominant source of heavy metal loading to the upper Sacramento River during storms. Uncontrolled SCDD spills are expected to occur on average every 3 to 4 years if the SCDD is operated to achieve the SBPS below Keswick Dam. Operating the SCDD to meet the

recently proposed PCTR (below Keswick Dam) would cause the spills to occur ever 2 to 3 years on average. Spills would occur even more frequently if the SCR were operated to target compliance with these standards in Keswick Reservoir rather than downstream of Keswick Dam. If dilution water releases can be made available from Shasta Dam, then the uncontrolled SCDD spill would be diluted, thereby minimizing its impact on the environment. This alternative, however, does not involve any action to ensure such flows will be available, so reliance upon such flows would be speculative. IMM would continue to discharge large volumes of heavy metal precipitates into the waters of the State. Some of these precipitates would become toxic sediments, adversely affecting benthic organisms and water column species and their habitat. High metal loads would continue to cause sub-lethal effects on aquatic resources.

The alternatives which increase SCDD capacity (Alternatives WM1, WM2, and WM3) reduce the frequency of an uncontrolled spill from the SCDD, which would decrease the frequency of the exceedances of the SBPS and PCTR below the SCDD. Alternative WM1 would reduce SCDD spill frequency to approximately one to three spills per century. Alternatives WM2 and WM3, which combine dam enlargement with treatment of the base flow from Slickrock Creek, are estimated to reduce the amount of metals released into the environment by about 30 to 35 percent (copper) and 20 to 25 percent (zinc and cadmium) on average compared to Alternatives WM0 or WM1. Alternatives WM2 and WM3 would reduce spills to a frequency of one per century or less. Alternative WM3 attempts to minimize the impact of the rare uncontrolled spills by arranging for purchase of some of the required dilution water. The other two alternatives rely on current operations of Shasta Dam to the extent special releases of dilution water could be made available and if downstream conditions would allow for the releases. None of these alternatives would attain safe and protective metal levels in the SCAKR. The severe impacts above the SCDD remain unabated.

Alternative WM4 is expected to provide the most protection of the environment because the remedy provides the greatest reduction in metals discharges. The remedy would be designed to treat all contaminated flows up to a 100-year, 3-day storm, so Alternative WM4 would reduce SCR contaminant spills to less than once per century. This remedy could generally achieve safe and protective metal levels in the SCAKR. The alternative is also expected to improve the water quality in the receiving waters in the Spring Creek watershed (including Spring Creek, and possibly Boulder and Slickrock Creeks) because the remedy would remove the large metal loads that would otherwise be discharged to those creeks. While EPA would not anticipate that all beneficial uses would be restored, the conditions could potentially improve to a point that many uses are partially restored. Additional response actions might also be available to further enhance those water bodies, such as removal of the contaminated stream sediments.

Alternative SR1 involves treatment of the Slickrock Creek area sources discharging to the most heavily impacted area of Slickrock Creek. The treatment of those sources is expected to on average reduce the release of copper by 60 to 70 percent and zinc and cadmium by 40 to 50 percent compared to Alternatives WM0 and WM1. The alternative is expected to reduce the frequency of SCDD spills to once every 8 to 10 years (when the SCDD is operated to

target compliance with the SBPS below Keswick Dam). The duration and toxicity of spills would be reduced from the spills that would occur under Alternatives WM1, WM2, and WM3. Alternative SR1 would also improve the water quality in the SCAKR and therefore reduce the risk to species in that watershed. The alternative is also expected to improve the water quality in the receiving waters in Spring Creek and Slickrock Creek because the remedy would remove the large metal loads that would otherwise be discharged to those creeks. While EPA would not anticipate that all beneficial uses would be restored to those creeks, the conditions could potentially improve to a point that some uses are partially restored. This remedy could potentially be more protective than Alternative WM4 with respect to lower Slickrock Creek because Alternative SR1 involves diverting relatively less contaminated water to the lower reach of Slickrock Creek, which would provide dilution water and additional flow to that reach. The alternative is less protective than Alternative WM4 with respect to Spring Creek and Boulder Creek because Alternative SR1 does not address the metal being discharged to Boulder Creek. Alternative SR1 would also reduce the risks posed by the continuing release of arsenic from the hematite piles in the Slickrock Creek basin.

Alternative SR1, in combination with a subsequent remedy for the Boulder Creek area sources, is expected to be able to reduce metal loads to practically the same degree as Alternative WM4, if necessary. Alternative SR1, in combination with a Boulder Creek area source remedy, is expected to be able to reduce SCDD spills to less than once per century, if necessary, and to reduce mass metal loading to State waters to practically the same degree as Alternative WM4. Alternative SR1, in combination with available alternatives for Boulder Creek, could approach or equal Alternative WM4 with respect to protecting Keswick Reservoir and the water bodies upstream of the SCDD. Additional response actions might also be available to further enhance those water bodies.

All of the remedies rely upon continuation of the existing treatment operations, and several of the remedies involve treatment of additional flows. Although operational upsets of the treatment plant are expected to be rare, occasional spills from the treatment plant related to operational problems are expected. The effect of treatment plant upsets is not expected to substantially impact the overall protectiveness of the remedial approaches that rely on treatment. The SCR would be relied on as a backup measure to store these contaminated plant spills until they could be safely released into the Sacramento River.

Overall, the No-Action Alternative provides inadequate environmental protection. The SCDD enlargement alternatives (WM1, WM2, and WM3) provide adequate to high levels of protection of the environment below Keswick Dam and some additional protection to the environment in Keswick Reservoir. Alternatives WM1, WM2 and WM3 do not appreciably improve conditions upstream of the SCDD; Alternative WM4 provides the greatest protection to the environment both above and below the SCDD. Alternative WM4 is also most effective in terms of reducing the mass loading of heavy metals to the waters of the State and provides the greatest potential for restoration of some beneficial uses above the Spring Creek Debris Dam. Alternative SR1 provides significant protection to resources below the SCDD and the potential for some additional protection for reaches of Spring Creek and Slickrock Creek. Alternative SR1 coupled with an available response action in Boulder

Creek could provide protection equivalent to Alternative WM4 and superior to Alternatives WM0, WM1, WM2, and WM3.

Table 2 presents a comparison of each alternative's ability to protect human health and the environment.

TABLE 2
Summary of Overall Protection of Human Health and the Environment
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
Alternative WM0–No Further Action.	Human health risk is expected to be low. If the SCDD is operated to achieve the SBPS below Keswick Dam, uncontrolled SCDD spills are expected to occur on average every 3 to 4 years. Operating the SCDD to target the PCTR below Keswick Dam would cause the spills to occur ever 2 to 3 years on average. Spills would occur even more frequently if the SCR were operated to target compliance with these standards in Keswick Reservoir rather than downstream of Keswick Dam. Repeated uncontrolled SCDD spills may increase severity of environmental impacts. Spring Creek arm of Keswick Reservoir continues to have regular exceedances of the SBPS and PCTR. IMM AMD would continue to discharge very large loads of heavy metals to State waters and expose aquatic resources to sub-lethal levels of dissolved and particulate heavy metals. No environmental improvement above SCDD.
Alternative WM1–Enlarge SCR to 15,000 acre-feet and dilute uncontrolled spill water, if dilution water is available.	Human health risk is expected to be low. Significant environmental impact reduction by reducing SCDD spill frequency to two to three times in 100 years if SCDD targets compliance with the SBPS below Keswick Dam; AMD spills expected to occur more frequently if SCDD targets compliance with the PCTR below Keswick Dam. Spring Creek arm of Keswick Reservoir continues to have regular exceedances of the SBPS and PCTR. Release of mass metal loads from IMM to State waters continues unabated; risk to benthic, water column, and other species because of continuous exposure to large loads of dissolved and particulate heavy metals. No environmental improvement above SCDD.

TABLE 2
Summary of Overall Protection of Human Health and the Environment
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
Alternative WM2–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water, if dilution water is available.	Human health risk is expected to be low. Provides significant environmental impact reduction by reducing SCDD spill frequency to once in 100 years or better (assuming SCDD targets compliance with the SBPS below Keswick Dam) and by reducing toxicity of spills relative to Alternative WM1 (because of baseflow treatment); exceedances of the PCTR would be more frequent than exceedances of the SBPS. Targeting SCDD operations to attain PCTR would be expected to cause more frequent spills and SBPS exceedances. The treatment of Slickrock Creek base flows will reduce metals loads by 30 to 35 percent (copper) and 20 to 25 percent (zinc and cadmium) and significantly reduce metals concentrations in SCR, Keswick Reservoir, and the Sacramento River. Spring Creek arm of Keswick Reservoir continues to have regular exceedances of the SBPS and PCTR. Mass metal loads from IMM AMD reduced by 30 to 35 percent (copper) and 20 to 25 percent (zinc and cadmium) on average, but loading to State waters still very large; releases continue to pose risk to benthic, water column, and other species because of continuous exposure to large loads of dissolved and particulate heavy metals. Potential for minor environmental improvement above SCDD.
Alternative WM3–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water with purchased dilution water.	Human health risk is expected to be low. Provides significant environmental impact reduction by reducing SCDD spill frequency to once in 100 years or better (assuming SCDD targets compliance with the SBPS below Keswick Dam) and by reducing toxicity of spills relative to Alternative WM1 (because of baseflow treatment) and WM2 (due to purchased dilution water); exceedances of the PCTR would be more frequent than exceedances of the SBPS. Targeting SCDD operations to attain PCTR would be expected to cause more frequent spills and SBPS exceedances. The treatment of Slickrock Creek base flows will reduce metals loads by 30 to 35 percent (copper) and 20 to 25 percent (zinc and cadmium) and significantly reduce metals concentrations in SCR, Keswick Reservoir, and the Sacramento River. Because dilution water is available, severity of uncontrolled SCDD spills can be reduced. Spring Creek arm of Keswick Reservoir continues to have regular exceedances of the SBPS and PCTR. Mass metal loads from IMM AMD reduced by 30 to 35 percent (copper) and 20 to 25 percent (zinc and cadmium) on average, but loading to State waters still very large; releases continue to pose risk

TABLE 2
Summary of Overall Protection of Human Health and the Environment
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
	to benthic, water column, and other species because of continuous exposure to large loads of dissolved and particulate heavy metals. Potential for minor environmental improvement above SCDD.
Alternative WM4–Rely on the existing SCDD for backup for plant failures, build two alternative dams (one in Slickrock Creek and one in Boulder Creek), build clean-water diversions, and collect and treat all contaminated water.	Human health risk is expected to be low. The treatment of all AMD will essentially eliminate the IMM metals discharge and greatly reduce metals concentrations in SCR, Keswick Reservoir, and the Sacramento River. The SCR can be relied upon to prevent spills to the Sacramento River. SBPS and PCTR expected to be met in Spring Creek arm of Keswick Reservoir except during most extreme and unusual events. Increased potential for environmental improvement above SCDD relative to other alternatives.
Alternative SR1–Construct a dam in Slickrock Creek and clean-water diversions, collect and treat all contaminated Slickrock Creek runoff, and build a retaining structure for the hematite pile.	Human health risk is expected to be low. The treatment of Slickrock Creek AMD will reduce under all conditions the metals load by 60 to 70 percent (copper) and 40 to 50 percent (zinc and cadmium), and significantly reduce the metals concentrations in SCR, Keswick Reservoir, and the Sacramento River below Keswick Dam. SCDD spills will be less toxic and reduced to once every 8 to 10 years if SCDD operated to target compliance with the SBPS below Keswick Dam; SCDD spills expected every 4 to 8 years if the SCDD is operated to target compliance with the PCTR below Keswick Dam. Spring Creek arm of Keswick Reservoir continues to have regular exceedances of the SBPS and PCTR. Potential for some environmental improvement above SCDD. Mass metal loads from IMM AMD reduced by 60 to 70 percent (copper) and 40 to 50 percent (zinc and cadmium) under all flow conditions. Reduction in risk to benthic, water column, and other species due to decrease in exposure to large loads of dissolved and particulate heavy metals. Alternative SR1 can later be combined with an appropriate area source remedial alternative for Boulder Creek (such as those developed and evaluated in EPA's Boulder Creek Remedial Alternative Study). Combining Alternative SR1 with a subsequent Boulder Creek area source remedy could reduce spills to once in 100 years and reduce spill toxicity and duration. Additional source controls could provide further reductions as necessary; combined remedy could potentially

TABLE 2
Summary of Overall Protection of Human Health and the Environment
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
	reduce mass loading from IMM AMD by significant amount and permit attainment of standards in the Spring Creek arm of Keswick Reservoir and restoration of at least some beneficial uses to Spring Creek watershed waters.

VIII.2 Criterion 2—Compliance with Applicable or Relevant and Appropriate Requirements and To Be Considered Standards

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or State environmental siting law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site.

Compliance with ARARs addresses whether a remedy will meet all Federal and State environmental laws and/or provide a basis for a waiver from any of these laws. These ARARs are divided into chemical-specific, action-specific, and location-specific groups.

In addition to legally binding laws and regulations, EPA is to consider proposed standards and other guidance that, while not legally binding, provide useful information regarding the performance of the remedy. These other standards are referred to as "To Be Considered" standards or TBCs. As discussed above, the EPA recently promulgated draft statewide numeric water quality criteria (the PCTR). If the criteria had been finalized by the time of ROD signature, the criteria would apply to this action. The EPA considers these criteria as TBC because the criteria provide useful information regarding risks posed by AMD releases. The PCTR are based on well established procedures for deriving water quality criteria, and the criteria take into account a wide array of aquatic toxicity issues. Consideration of the criteria will enable EPA to predict ARARs that are likely to apply to future response actions. The EPA has therefore evaluated the extent to which the proposed remedy would comply with these proposed standards. In general, targeting SCDD operations to attain compliance with the PCTR increases the frequency of exceedances of the SBPS because water must be released from the SCR more slowly. Targeting SCDD operations to attain compliance with the SBPS results in frequent exceedances of the PCTR chronic water quality criteria for copper because the SBPS are less stringent than the PCTR with respect to copper.

ARAR Compliance Upstream of Spring Creek Debris Dam

None of the alternatives fully complies with ARARs because none of the alternatives would achieve SBPS or the PCTR in Spring Creek, Slickrock Creek, or Boulder Creek. Depending upon subsequent remedial decisionmaking, EPA may ultimately need to waive at least some of the ARARs for these heavily impacted water bodies on the basis of technical impracticability. The EPA requested comment on a proposed ARAR waiver for these streams during public comment period.

None of the streams above the SCDD currently support aquatic life, and no option has yet been developed which would effectively restore all these streams to life. The remedial actions implemented to date, and those considered in the 1994 FS and 1996 FSA, may allow for the restoration of some beneficial uses to these surface waters. It is expected that any ARAR waiver would be limited to those response actions which would be technically impracticable, and would not extend to clearly feasible measures, such as compliance with Best Management Practices, SBPS, other ARARs for current control measures at IMM, or feasible actions to provide incremental improvements of the toxicity criteria which may improve conditions for more tolerant life forms, such as plants and invertebrates, even if more stringent toxicity criteria cannot be met.

ARAR Compliance in Keswick Reservoir

Alternative WM4 would achieve compliance with ARARs in Keswick Reservoir in most circumstances, but occasional exceedances in Keswick Reservoir may occur as a result of the difficult operations that are required to manage the safe dilution of the peak discharges of stormwater runoff. Alternative SR1, in combination with certain potential remedial actions for the Boulder Creek area source AMD discharges, could also allow for compliance with ARARs in Keswick Reservoir in most circumstances. Alternatives WM2 and WM3 are expected to result in some improvement in water quality in Keswick Reservoir over Alternatives WM0 and WM1 because of the increased treatment.

ARAR Compliance below Keswick Dam

Alternatives WM1 through WM3 would meet SBPS below Keswick Dam in all but the most unusual events, projected at one to three times per century, depending on the availability of dilution water in those years (with slightly a greater frequency of spills expected if the SCDD is targeting compliance with the PCTR below Keswick Dam). Alternatives WM2 and WM3 would more reliably meet the SBPS than Alternative WM1 because those alternatives remove a significant concentration of metals from the water impounded behind SCDD. Of the two, compliance with SBPS and PCTR may be somewhat more reliable in the extreme events under WM3 because Alternative WM3 would rely upon the exercise of water rights (to the extent they become available), while Alternative WM2 contains no such protection.

Alternative SR1 would meet the SBPS below Keswick Dam except during IMM AMD spills from SCDD, which are projected to occur on a frequency of once every 8 to 10 years (when the SCDD is operated to target compliance with the SBPS below Keswick Dam). The metal concentrations and thus the toxicity of the spills would be reduced because of the treatment of the Slickrock Creek area source discharges. Alternative SR1 would also significantly reduce the duration of the spill events, because treatment would cause the SCR water to be less toxic

and therefore permit release at a faster rate. Operating the SCDD to target compliance with the PCTR below Keswick Dam is predicted to result in exceedances every 4 to 8 years.

Of the five alternatives, Alternative WM4 best complies with water quality standard ARARs and TBCs below the SCDD.

All treatment options (Alternatives WM2 through WM4 and SR1) rely upon established treatment technologies. To the extent that any treated sludge exceeds the standards for hazardous waste under applicable California law, the treatment option would require a variance from standards applicable to the disposal of mining waste. Current response actions (including the ongoing treatment plant operations and sludge disposal) rely upon a variance from such standards. Since each of the treatment alternatives relies upon the same treatment plant and technology, it is not anticipated that there will be any significant degree of difference among the treatment alternatives in their relative compliance with the State mining waste standards.

Insofar as all the action alternatives further the goals of the various natural resource protection ARARs identified for this Site, they all help in meeting ARARs. Of the treatment options, however, Alternative WM4 best achieves the goals of Fish and Game Code Section 5650, which prohibits the discharge of material deleterious to fish life, and Section 5651, which encourages the implementation of best available control technology on chronic pollution sources. Alternatives WM1 through WM3 and SR1 all further this goal to some degree, relative to the degree by which they reduce the metals loading from Site discharges and permit compliance with the SBPS and PCTR in receiving waters.

Alternatives WM1 through WM4 and SR1 also all help achieve the ends of the State Endangered Species Act and Federal Endangered Species Act because all will result in substantial improvements in water quality below Keswick Dam, which is the location of the endangered winter-run chinook salmon and other important species such as the steelhead trout and spring run salmon. Alternative WM4 best achieves this ARAR because it provides a more consistent level of protection. Alternatives WM1 through WM3 and SR1 also provide substantial protection because the chances of a spill event are reduced to one to seven per century. Alternative WM3 is the best option of the three alternatives that rely on an enlarged SCR in that it provides both treatment and a more reliable dilution option in those spill years in which dilution is feasible. Alternative SR1 provides greater reduction in the metals discharge than these three alternatives, but would allow for more frequent, although less toxic, spills. Alternative SR1, in combination with an appropriate subsequent remedy for the Boulder Creek area sources, could potentially provide protection from SCDD spills essentially equivalent to Alternatives WM1 through WM4 and additional reduction in the Site metals discharge loads both above and below the SCDD.

Alternatives WM1 through WM4 and SR1 would comply with the Fish and Wildlife Coordination Act, an ARAR for those actions. Significantly less mitigation for remedial actions SR1 and WM4 is expected because the areas in which containment ponds would be established are currently highly impacted by the past mining activity.

ARAR Exceedances Because of Sediments

With respect to all options, it is anticipated that occasional re-suspension of sediments now located in the SCAKR could result in exceedances of ARARs, notably Fish and Game Code Section 5650 and SBPS, both in Keswick Reservoir and below Keswick Dam. Because these sediments are not being addressed in this action, but will be addressed in a subsequent study, it would be appropriate to invoke an interim remedy ARARs waiver to the degree it is anticipated these sediments may result in ARARs exceedances.

Alternative SR1 would also achieve compliance with state mining laws with respect to control of the hematite piles.

Table 3 below presents a summary of each alternative's compliance with ARARs.

TABLE 3
Summary of Compliance with ARARs
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
Alternative WM0–No Further Action.	If the SCDD is operated to achieve the SBPS below Keswick Dam, uncontrolled SCDD spills are expected to occur on average every 3 to 4 years. SBPS attained below Keswick Dam during non-spill periods but PCTR exceeded below Keswick Dam even during non-spill periods. Operating the SCDD to target the PCTR below Keswick Dam would cause the spills to occur every 2 to 3 years on average. Spills would occur even more frequently if the SCR were operated to target compliance with these standards in Keswick Reservoir rather than downstream of Keswick Dam. PCTR and SBPS would continue to be exceeded in Keswick Reservoir and the creeks that drain Iron Mountain. Does not further the goal of Fish & Game Code Sections 5650 and 5651. No archeological and/or historical sites would be disturbed. No flood plains or wetlands would be disturbed. Uncontrolled SCDD spills of toxic AMD discharges threaten the endangered winter-run chinook salmon.
Alternative WM1–Enlarge SCR to 15,000 acre-feet and dilute uncontrolled spill water, if dilution water is available.	SCDD spill frequency reduced to two to three times in 100 years if SCDD targets compliance with the SBPS below Keswick Dam; SBPS attained below Keswick Dam during non-spill periods but PCTR exceeded below Keswick Dam even during non-spill periods. AMD spills expected to occur more frequently if SCDD targets compliance with the PCTR below Keswick Dam. The SBPS are expected to be exceeded in the Sacramento River below Keswick Dam because of AMD spills one to three times per century. PCTR and SBPS would continue to be exceeded in Keswick Reservoir and the creeks that drain Iron Mountain. Exceedances of the PCTR would be more frequent than exceed-

TABLE 3
Summary of Compliance with ARARs
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
	ances of the SBPS; targeting SCDD operations to attain PCTR would cause more frequent spills and SBPS exceedances. Furthers goal of Fish & Game Code Sections 5650 and 5651 only below SCDD. Exceedances because of sediments to continue. No archeological and/or historical sites will be disturbed. No harmful impacts to endangered species are anticipated. The EPA continues to coordinate with State and Federal Natural Resource Trustees, and consult with NMFS consistent with the provisions of the Endangered Species Act. Mitigation is required related to expected unavoidable impacts to chaparral and riparian habitat. In accordance with the Fish and Wildlife Coordination Act, EPA would consult with the USFWS during design of this alternative.
Alternative WM2–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water, if dilution water is available.	SCDD spills expected once in 100 years if SCDD targets compliance with the SBPS below Keswick Dam; SBPS attained below Keswick Dam during non-spill periods but PCTR exceeded below Keswick Dam even during non-spill periods. AMD spills expected to occur more frequently if SCDD targets compliance with the PCTR below Keswick Dam. Exceedance of SBPS and PCTR reduced during spill periods due to baseflow treatment. PCTR and SBPS would continue to be exceeded in Keswick Reservoir and the creeks that drain Iron Mountain. Furthers goal of Fish & Game Code Sections 5650 and 5651 primarily below SCDD. Exceedances because of sediments to continue. No archeological and/or historical sites would be disturbed. No harmful impacts to endangered species are anticipated. The EPA continues to coordinate with State and Federal Natural Resource Trustees, consistent with the provisions of the Endangered Species Act. Mitigation is required related to expected unavoidable impacts to chaparral and riparian habitat. In accordance with the Fish and Wildlife Coordination Act, EPA would consult with the USFWS during design of this alternative.
Alternative WM3–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water with purchased dilution water.	SCDD spills expected once in 100 years if SCDD targets compliance with the SBPS below Keswick Dam; SBPS attained below Keswick Dam during non-spill periods but PCTR exceeded below Keswick Dam even during non-spill periods. AMD spills expected to occur more frequently if SCDD targets compliance with the PCTR below Keswick Dam. Exceedance of SBPS and PCTR reduced during spill

TABLE 3
Summary of Compliance with ARARs
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
	periods due to baseflow treatment and purchased dilution water.
	PCTR and SBPS would continue to be exceeded in Keswick Reservoir and the creeks that drain Iron Mountain.
	Furthers goal of Fish & Game Code Sections 5650 and 5651 primarily below SCDD.
	Exceedances because of sediments to continue.
	No archeological and/or historical sites would be disturbed.
	No harmful impacts to endangered species are anticipated. The EPA continues to coordinate with State and Federal Natural Resource Trustees and consult with NMFS consistent with the provisions of the Endangered Species Act.
	Mitigation is required related to expected unavoidable impacts to chaparral and riparian habitat. In accordance with the Fish and Wildlife Coordination Act, EPA would consult with the USFWS during design of this alternative.
Alternative WM4–Rely on the existing SCDD for backup for plant failures, build two alternative dams (one on Slickrock Creek and one on Boulder Creek), build clean-water diversions, and collect and treat all contaminated water.	SCDD spills expected once in 100 years if SCDD targets compliance with the SBPS below Keswick Dam; SBPS attained below Keswick Dam during non-spill periods but PCTR exceeded below Keswick Dam even during non-spill periods. AMD spills expected to occur more frequently if SCDD targets compliance with the PCTR below Keswick Dam.
	SBPS and PCTR attained in Keswick Reservoir except in unusual circumstances.
	PCTR and SBPS expected to be exceeded in the creeks that drain Iron Mountain but to a lesser degree than the other alternatives.
	Furthers goal of Fish & Game Code Sections 5650 and 5651 both above and below the SCDD.
	Exceedances because of sediments to continue.
	No archeological and/or historical sites would be disturbed.
	No harmful impacts to endangered species are anticipated. The EPA continues to coordinate with State and Federal Natural Resource Trustees and consult with NMFS, consistent with the provisions of the Endangered Species Act.
	Mitigation may be required related to expected unavoidable impacts to chaparral and riparian habitat that is currently highly impacted by historic mining. In accordance with the Fish and Wildlife Coordination Act, EPA would consult with the USFWS during design of this alternative.

TABLE 3
Summary of Compliance with ARARs
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
Alternative SR1–Construct a dam in Slickrock Creek and clean-water diversions, collect and treat all contaminated Slickrock Creek runoff, and build a retaining structure for the hematite pile.	SCDD spills expected every 8 to 10 years on average if SCDD targets compliance with the SBPS below Keswick Dam; SBPS attained below Keswick Dam during non-spill periods but PCTR exceeded below Keswick Dam even during non-spill periods. AMD spills expected to occur more frequently if SCDD targets compliance with the PCTR below Keswick Dam. SBPS and PCTR are also expected to be exceeded in Keswick Reservoir and the creeks that drain Iron Mountain. Furthers goal of Fish & Game Code Sections 5650 and 5651 below the SCDD and to some degree on Slickrock Creek and lower Spring Creek. Exceedances because of sediments to continue. No archeological and/or historical sites would be disturbed. Alternative SR1 does not fully eliminate all spills from SCDD, does not delay spills as the enlarged SCDD alternatives do, and would not prevent all harm to endangered species. Additional actions in Boulder Creek could further reduce the frequency, toxicity, and duration of spills, providing significant additional protection to endangered species. The EPA continues to coordinate with State and Federal Natural Resource Trustees and consult with NMFS, consistent with the provisions of the Endangered Species Act. Mitigation may be required related to expected unavoidable impacts to chaparral and riparian habitat that is currently highly impacted by historic mining. In accordance with the Fish and Wildlife Coordination Act, EPA would consult with the USFWS during design of this alternative.

VIII.3 Criterion 3—Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to the ability of a remedy to maintain reliable protection of human health and the environment over time. This criterion includes the consideration of residual risk and the adequacy and reliability of controls.

Under the No Further Action Alternative, WM0, long-term effects would continue as under their present condition. The discharge of areawide sources of AMD would continue for thousands of years if left unabated. The affected portion of Spring Creek watershed will continue to be devoid of aquatic life, amphibians, and other affected resources. Sediments containing elevated levels of metals would continue to be deposited in the creeks, behind SCDD, and in SCAKR. Uncontrolled spills of IMM contaminants would continue to occur every 3 to 4 years if the SCR is operated to target the SBPS below Keswick Dam and every 2 to 3 years if the SCR is operated to target the PCTR below Keswick Dam.

Alternatives WM2 and WM3 would remove an estimated 30 to 35 percent (copper) and 20 to 25 percent (zinc and cadmium) of the remaining uncontrolled Site discharge by treating up to 50 percent of the Slickrock Creek area source AMD metals discharge load. The remedy would treat a larger percent when flows are low and a smaller percent when flows are high. Alternative SR1 would remove essentially all of the Slickrock Creek area source AMD discharge load. (In the EPA Water Quality Model, EPA generally relied upon an efficiency of 90 percent as a conservative estimate, but EPA anticipates that the remedy will be more effective than that estimate.) The Slickrock Creek area sources comprise approximately 60 to 70 percent of the remaining uncontrolled copper and 40 to 50 percent of the remaining uncontrolled zinc and cadmium site discharges. Alternative WM4 would remove essentially 100 percent of the remaining Site discharge load. Alternative SR1, in combination with a subsequent Boulder Creek area source remedy, could equal or approach the metal reduction provided by Alternative WM4. Alternatives WM1 and WM0 would not provide for any additional metals removal.

Enlarging the SCR to a capacity of 15,000 acre-feet, as proposed in Alternatives WM1, WM2, and WM3, is expected to provide significant, effective, long-term protection to human health and the environment below Keswick Dam. An enlarged dam would require periodic maintenance, but is expected to have a project design life in excess of 100 years. The enlarged SCR is a passive device that is expected to provide significant additional hydrologic controls. The additional hydrologic controls would provide for a significant reduction in toxic spill frequency and greater compliance with the protective SBPS and PCTR below the SCDD than is possible under current conditions. Enlarged SCR capacity would also provide additional protection with respect to treatment plant upsets because the enlarged reservoir would increase the ability to control the dilution of highly polluted water from the SCR.

Reducing the metal load to the SCR reduces the frequency of SCDD spills. If the water in the SCR contains lower concentrations of metals, the reservoir can release the water at faster rate because less dilution water would be needed. Alternatives WM2, WM3, WM4, and SR1 reduce metals discharges and therefore reduce spill frequency associated with operation of either the enlarged SCR (in the case of Alternatives WM2 and WM3) or the existing SCR (in the case of Alternatives WM4 or SR1). When coupled with the other response actions, this additional reduction in SCDD spills associated with the metals removal provides significant additional compliance with the protective SBPS and the PCTR below the SCDD and thus protection to the Sacramento River fishery and ecosystem. The metals reduction also decreases the overall metals discharge loading, the exposure of aquatic resources to heavy metals, and the resultant amount of metals deposition in the sediments behind SCDD and in the SCAKR. The continued deposition of sediments poses a threat to benthic and water column organisms as well as hindering the ability to effectively respond to the sediments caused by past IMM AMD releases. Removal of metals also increases the potential for the beneficial uses of Spring Creek and its tributaries to be restored.

All the alternatives would rely on the release of dilution water, if possible, to mitigate damage from the uncontrolled spills. Dilution water would be more likely to be available under Alternative WM3 because that alternative provides for the purchase of water rights for dilution water.

Alternative WM4 would provide the greatest long-term effectiveness by significantly reducing the metals discharged to the environment. The proposed treatment of all areawide sources by capturing the creek flows on Boulder and Slickrock Creeks and treating all contaminated flows would reduce the amount of metals by an estimated 99 percent. Contaminated creek sediments in the contaminated reaches of the Spring Creek watershed would continue to discharge metals for some period of time. The existing heavy metal-laden sediments in SCAKR could also act as a metal source as metals re-dissolve into the water. The operation of a treatment scheme that requires the collection and treatment of all storm flows is a difficult task, and cannot be expected to function perfectly. Some upset condition operations should be anticipated to reduce the overall effectiveness of this approach. Alternative SR1 could potentially be coupled with other response actions to achieve protection that is comparable to Alternative WM4.

Table 4 below presents a comparison of each alternative's ability to meet this criterion.

TABLE 4
Summary of Long-Term Effectiveness and Permanence
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
Alternative WM0–No Further Action.	Not effective. Because no additional remedial action is implemented, environmental impacts will continue over the long term under their present condition. Metals releases and current risks may continue for thousands of years.
Alternative WM1–Enlarge SCR to 15,000 acre-feet and dilute uncontrolled spill water, if dilution water is available. •	Provides substantial long-term effectiveness for protection of human health and the environment. Infrequent fishery impacts below Keswick Dam are expected because of SCDD spills that would occur two to three times in 100 years. Aquatic resources below SCDD continue to be exposed to large loads of total and dissolved heavy metals. Receiving waters upstream of SCDD continue to be devoid of aquatic life; portion of Keswick Reservoir remains impaired. Heavy metal-laden sediments would continue to accumulate. Better control over SCDD releases during storm events is anticipated.
Alternative WM2–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water, if dilution water is available.	Provides significant long-term effectiveness for protection of human health and the environment. Rare fishery impacts below Keswick Dam are expected because of spills that would occur less than once in 100 years. Below SCDD, baseflow treatment permits reduction in metal loading (on average 30 to 35 percent [copper] and 20 to 25 percent [zinc and cadmium]), thereby reducing the exposure of aquatic resource to large loads of total and dissolved heavy metals. Heavy metal-laden sediments would continue to accumulate, but at a reduced rate.

TABLE 4
Summary of Long-Term Effectiveness and Permanence
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
	Receiving waters upstream of SCDD continue to be devoid of aquatic life; Keswick Reservoir remains impaired.
	The collection system, pipelines, and treatment plant should operate effectively. Treatment of the AMD with the HDS plant is very reliable, and the plant would remove 99 percent of the metals discharged. Disposal of the treatment sludge in Brick Flat Pit would be effective over the long term.
	Better control over SCDD releases during storm events is anticipated.
Alternative WM3–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water with purchased dilution water.	Provides significant long-term effectiveness for protection of human health and the environment. Rare fishery impacts below Keswick Dam are expected because of SCDD spills that would occur once in 100 years. Mitigation with dilution water would reduce the impact of the rare spill.
	Below SCDD, baseflow treatment permits reduction in metal loading (on average 30 to 35 percent [copper] and 20 to 25 percent [zinc and cadmium]), thereby reducing the exposure of aquatic resource to large loads of total and dissolved heavy metals. Heavy metal-laden sediments would continue to accumulate, but at a reduced rate.
	Receiving waters upstream of SCDD continue to be devoid of aquatic life; Keswick Reservoir remains impaired.
	The collection system, pipelines, and treatment plant should operate effectively. Treatment of the AMD with the HDS plant is very reliable, and the plant would remove 99 percent of the metals discharged. Disposal of the treatment sludge in Brick Flat Pit would be effective over the long term.
	Better control over SCDD releases during storm events is anticipated.
Alternative WM4–Rely on the existing SCDD for backup for plant failures, build two alternative dams (one on Slickrock Creek and one on Boulder Creek), build clean-water diversions, and collect and treat all contaminated water.	Provides significant long-term effectiveness for protection of human health and the environment. SCDD spills would be expected to occur only under the rarest of circumstances.
	Essentially eliminates the IMM metals discharge. Heavy metal-laden sediments would not continue to accumulate.
	Significant reduction in exposure of aquatic resource to large loads of total and dissolved heavy metals.
	The dams, pipelines, and treatment plant should operate effectively. Treatment of the AMD with the HDS plant is very reliable, and the plant would remove 99 percent of the metals discharged. Disposal of the treatment sludge in Brick Flat Pit would be effective over the long term.

TABLE 4
Summary of Long-Term Effectiveness and Permanence
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
Alternative SR1–Construct a dam in Slickrock Creek and clean water diversions, collect and treat all contaminated Slickrock Creek runoff, and build a retaining structure for the hematite pile	Provides significant long-term effectiveness for protection of human health and the environment. Occasional fishery impacts below Keswick Dam are expected because of spills that would occur once every 8 to 10 years.
	Provides significant reduction (60 to 70 percent copper and 40 to 50 percent zinc and cadmium) in metals load discharge under all conditions. Heavy metal-laden sediments would continue to accumulate, but at a much reduced rate.
	Potential for restoration of some beneficial uses of waters in Spring Creek Watershed. The collection system, pipelines, and treatment plant should operate effectively. Treatment of the AMD with the HDS plant is very reliable, and the plant would remove 99 percent of the metals discharged. Disposal of the treatment sludge in Brick Flat Pit would be effective over the long term.
	Alternative SR1 can later be combined with an appropriate area source remedial alternative for Boulder Creek (such as those developed and evaluated in EPA's Boulder Creek Remedial Alternative Study).
	Alternative SR1, combined with an appropriate Boulder Creek source control and treatment remedy, is expected to be able to achieve further significant metal load reductions. The further load reductions in Boulder Creek could reduce spill frequency to less than once per century, which is comparable to Alternatives WM2, WM3, and WM4 and increases the potential for restoration of the beneficial uses of Spring Creek and its tributaries.

VIII.4 Criterion 4—Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the preference for a remedy that uses treatment to reduce health hazards, contaminant migration, or the quantity of contaminants at the Site.

The No Further Action Alternative, WM0, is not expected to provide a reduction in toxicity, mobility, or volume because no further reductions in the IMM metal discharges would occur, and SCDD would continue to spill at its current frequency. Therefore, metals would continue to accumulate in the environment.

The SCDD enlargement alternatives will reduce the toxicity of the AMD discharge at the point below Keswick Dam to the SBPS through dilution, except during the one to three spills in 100 years. Exceedances of the PCTR below Keswick Dam would also be reduced. Alternative WM1 does not contain any treatment components; therefore, there will be no reduction

in mobility or volume of AMD discharge. Alternatives WM2 and WM3 would treat up to approximately 750 gpm of Slickrock Creek base flow, thereby reducing the volume of AMD discharge by about 240 gpm on average. On an annual average, baseflow treatment is expected to reduce the uncontrolled release of copper by 30 to 35 percent and the uncontrolled release of zinc and cadmium by 20 to 25 percent. The mobility of the untreated AMD discharge would remain unchanged. Ensuring the availability of dilution water in Alternative WM3 increases the probability that the toxicity of an uncontrolled SCDD spill can be reduced. Alternative WM4 treats all the areawide sources of AMD discharge collected in dams constructed on Slickrock and Boulder Creeks. Alternative WM4 would provide the greatest decrease in the toxicity and volume of these discharges and would reduce the mobility of the metal contaminants by separating and binding the metals in a sludge, which will be disposed of in a landfill to limit future re-mobilization.

Alternative SR1 provides greater reductions in the volumes of IMM area source contaminants discharged than Alternatives WM2 and WM3, and less than under Alternative WM4. Alternative SR1 would collect and treat (under all conditions) essentially all Slickrock Creek area source discharges, which comprise approximately 60 to 70 percent (copper) and 40 to 50 percent (zinc and cadmium) of the currently uncontrolled IMM AMD discharge. Alternative SR1 provides for a significant reduction in toxicity of the SCR waters. Because Alternative SR1 does not include the increased hydrologic controls of Alternatives WM2 and WM3, Alternative SR1 does not ensure the same degree of reduction in the toxicity in the Sacramento River. Alternative SR1 is estimated to reduce spills from the SCR to once every 8 to 10 years (when the SCDD is operated to target compliance with the SBPS below Keswick Dam). When combined with a remedy for the Boulder Creek area sources (to be the subject of additional study and a later EPA decision), the Alternative SR1 could potentially be comparable to the other alternatives with respect to reduction in toxicity in the Sacramento River and an equivalent or greater reduction in volume and mobility both above and below the SCDD.

Table 5 below presents a comparison of each alternative's ability to meet this criterion.

TABLE 5
Summary of Reduction of Toxicity, Mobility, or Volume through Treatment
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
Alternative WM0–No Further Action.	No reduction in toxicity, mobility, or volume.
Alternative WM1–Enlarge SCR to 15,000 acre-feet and dilute uncontrolled spill water, *if dilution water is available.*	Reduces the toxicity to SBPS below Keswick Dam of SCDD discharge except for one spill event per century (if SCDD operated to target compliance with SBPS below Keswick Dam). Also reduces exceedance of PCTR below Keswick Dam. No reduction in volume or mobility.
Alternative WM2–Enlarge SCR to 15,000 acre-feet,	Reduces the toxicity to SBPS below Keswick Dam of SCDD discharge except for one spill event per century (if SCDD operated to

TABLE 5
Summary of Reduction of Toxicity, Mobility, or Volume through Treatment
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water, if dilution water is available.	target compliance with SBPS below Keswick Dam). The uncontrolled SCDD spill should be less toxic than WM1. Also reduces exceedance of PCTR below Keswick Dam.
	Provides some reduction in volume and mobility of AMD by treating 750-gpm base flow of Slickrock Creek. Also reduces exceedance of PCTR below Keswick Dam.
	Provides some reduction in volume of heavy metal precipitates, but large volumes of precipitates continue to settle into reservoirs and river beds
Alternative WM3–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water with purchased dilution water.	Reduces the toxicity to SBPS below Keswick Dam of SCDD discharge except for one spill event per century (if SCDD operated to target compliance with SBPS below Keswick Dam). The uncontrolled SCDD spill should be less toxic than WM1.
	Provides some reduction in volume and mobility of AMD by treating 750-gpm base flow of Slickrock Creek.
	Guaranteed dilution water increases probability of reducing toxicity of uncontrolled SCDD spill.
	Provides some reduction in volume of heavy metal precipitates, but large volumes of precipitates continue to settle into reservoirs and river beds.
Alternative WM4–Rely on the existing SCDD as backup for plant failures, build two alternative dams (one in Slickrock Creek and one in Boulder Creek), build clean-water diversions, and collect and treat all contaminated water.	Reduces the toxicity to SBPS below Keswick Dam of SCDD discharge except for one spill event per century (if SCDD operated to target compliance with SBPS below Keswick Dam). The uncontrolled SCDD spill should be less toxic than Alternatives WM2 and WM3 because of increased removal of metals through treatment. Also reduces exceedance of PCTR below Keswick Dam.
	Greatly reduces toxicity, mobility, and volume of AMD by collecting and treating all IMM area sources of AMD.
	Greatly reduces volume of heavy metal precipitates and new sedimentation, thereby increasing potential for effective remediation of existing sediments.
	Treatment will improve the water quality in the Spring Creek watershed.
Alternative SR1–Construct a dam in Slickrock Creek and clean-water diversions, collect and treat all contaminated Slickrock Creek runoff, and build a retaining structure for the hematite pile.	Reduces the toxicity to SBPS below Keswick Dam of SCDD discharge except for one spill event every 8 to 10 years (if SCDD operated to target compliance with SBPS below Keswick Dam). The uncontrolled SCDD spills should be less toxic than Alternatives WM2 and WM3 because of increased removal of metals through treatment. Also reduces exceedance of PCTR below Keswick Dam.
	Significantly reduces the toxicity, mobility, and volume of AMD

TABLE 5
Summary of Reduction of Toxicity, Mobility, or Volume through Treatment
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
	discharges by collecting and treating essentially all Slickrock Creek area sources of AMD under all conditions.
	Some reduction (greater reduction than Alternatives WM1 and WM2) in volume of heavy metal precipitates and new sedimentation.
	Alternative SR1 can later be combined with an appropriate area source remedial alternative for Boulder Creek (such as those developed and evaluated in EPA's Boulder Creek Remedial Alternative Study).
	Alternative SR1, in combination with a Boulder Creek area source remedy, would be expected to provide equivalent reductions in the toxicity and frequency of spills provided under Alternatives WM2 and WM3 and greater reductions in volume and mobility of the contaminants. Combined remedy could potentially greatly reduce the volume of heavy metal precipitates and new sedimentation, thereby increasing the potential for effective remediation of existing sediments.
	Treatment will improve the water quality in the Spring Creek watershed.

VIII.5 Criterion 5—Short-Term Effectiveness

Short-term effectiveness refers to the period of time required to complete the remedy and any adverse impacts on human health and the environment that may be posed during the construction and implementation of the remedy.

Some degree of increased traffic and related impacts are expected during construction, but none of the alternatives pose a substantial threat to the local communities. The alternatives with construction components expose workers to normal construction-related impacts and expose the environment to minor impacts which can be mitigated during construction. The alternatives with treatment components expose treatment plant operators to some risk from being exposed to AMD, but through proper operation, maintenance, and protection, the risk is minor.

The No Further Action Alternative does not propose any new construction that would adversely affect the environment. This alternative will not meet the remedial action objectives and does not mitigate the present environmental risks.

For the SCDD enlargement alternatives, Alternatives WM1 through WM3, there is no substantial threat to local communities because of the remote location of the IMM Site. Iron Mountain Road would be permanently relocated, which would minimize traffic conflicts associated with the project. During construction, however, there would be increased traffic

on Iron Mountain Road. The project is large, but construction would be staged to reduce noise and dust impacts.

Environmental impacts of construction of an SCDD enlargement are expected to be minor, and it is anticipated that these impacts can be mitigated. The inundation of an additional 180 acres of land is an unavoidable minor impact. The EPA has consulted with USFWS regarding appropriate mitigation measures for an SCDD enlargement.

The two alternatives that treat the base flow from Slickrock Creek (Alternatives WM2 and WM3) will have only minimal additional short-term impacts because only minimal construction is required to modify the treatment plant and build conveyance pipelines to the existing treatment plant. Alternative WM4 requires a substantial amount of additional construction, including construction of two small dams, other water management projects, new pipelines, a significantly expanded treatment plant, and additional sludge handling facilities. During construction, Iron Mountain Road would experience greater traffic, as well as construction-related impacts such as dust and noise. Because the two new dams would be constructed upstream of the existing SCDD, a failure of one of these dams during construction would not present a threat to downstream residents.

Alternative SR1 requires substantial additional construction with a containment dam, the hematite containment structure, clean-water conveyances, new pipelines, and an expanded treatment plant. However, there would be less traffic and construction-related impacts such as dust and noise than in Alternatives WM1 through WM4. Because the new dam would be constructed upstream of the existing SCDD, a failure during construction would not present a threat to downstream residents. In the absence of rapid implementation of the remedy for Boulder Creek area sources, Alternative SR1 would be less effective in short-term reduction of metals, toxicity, and mobility than Alternative WM4. Investigation of Boulder Creek is continuing, so a remedy for those sources could potentially be implemented in the near-term.

The treatment alternatives share the common short-term advantage that the process can be readily modified to take advantage of improvements in treatment technology or changed economic conditions which may in the future favor resource recovery processes.

Table 6 below presents a comparison of each alternative's ability to meet this criterion.

TABLE 6
Summary of Short-Term Effectiveness
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
Alternative WM0–No Further Action.	Does not meet remedial action objectives. Workers at the treatment plant are exposed to work risks similar to those of chemical industry workers.
Alternative WM1–Enlarge SCR to 15,000 acre-feet and dilute uncontrolled spill water,	No substantial threats to the local communities are anticipated. Increase in traffic and related impacts during construction. Workers exposed to normal construction-related risks:

TABLE 6
Summary of Short-Term Effectiveness
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
if dilution water is available.	Minor environmental impacts during construction, which can be mitigated.
	Workers at the treatment plant are exposed to work risks similar to those of chemical industry workers.
Alternative WM2–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water, if dilution water is available.	No substantial threats to the local communities are anticipated. Increase in traffic and related impacts during construction.
	Workers exposed to normal construction-related risks.
	Minor environmental impacts during construction, which can be mitigated.
	Workers at the treatment plant are exposed to work risks similar to those of chemical industry workers.
Alternative WM3–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water with purchased dilution water.	No substantial threats to the local communities are anticipated. Increase in traffic and related impacts during construction.
	Workers exposed to normal construction-related risks.
	Minor environmental impacts during construction, which can be mitigated.
	Workers at the treatment plant are exposed to work risks similar to those of chemical industry workers.
Alternative WM4–Rely on the existing SCDD as backup for plant failures, build two alternative dams (one in Slickrock Creek and one in Boulder Creek), build clean-water diversions, and collect and treat all contaminated water.	No substantial threats to the local communities are anticipated. Increase in traffic and related impacts during construction. These impacts are greatest with this alternative because of the size of the project.
	Workers exposed to normal construction-related risks.
	Minor environmental impacts during construction, which can be mitigated.
	Workers at the treatment plant are exposed to work risks similar to those of chemical industry workers.

TABLE 6
Summary of Short-Term Effectiveness
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
Alternative SR1–Construct a dam in Slickrock Creek and clean water diversions, collect and treat all contaminated Slickrock Creek runoff, and build a retaining structure for the hematite pile.	No substantial threats to local communities are anticipated. Increase in traffic and related impacts during construction.
	Workers exposed to normal construction-related risks.
	Workers at the treatment plant are exposed to work risks similar to those of chemical industry workers.
	Minor environmental impacts during construction, which can be mitigated.
	The short-term effectiveness of an alternative that combines Alternative SR1 with a subsequent Boulder Creek remedy would be similar to other action alternatives; substantial delay in implementing a Boulder Creek remedy would cause Alternative SR1 to be less effective in the short-term than the other action alternatives.
	Alternative SR1 can later be combined with an appropriate area source remedial alternative for Boulder Creek (such as those developed and evaluated in EPA's Boulder Creek Remedial Alternative Study). Short-term impacts of those projects would likely be comparable to the SR1 projects because of the similarity in the nature of the problem being addressed and location.

VIII.6 Criterion 6—Implementability

Implementability refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the chosen solution. It also includes coordination of Federal, State, and local governments to clean up the Site.

All the technologies are readily implementable. All the materials and work force necessary for each alternative are readily available. The administrative implementability for each alternative is straightforward and easy.

The No-Action Alternative, WM0, requires no additional effort and is readily implementable. The only aspect of this alternative that requires active implementation is the operation of existing facilities. The continued implementation of this alternative is straightforward.

The technical implementability of an enlargement of SCDD proposed in Alternatives WM1, WM2, and WM3 is relatively straightforward. All of the technologies and construction techniques for dam enlargement required for these alternatives are well understood. Construction sequencing will be carefully planned and phased to minimize environmental and construction hazards.

The treatment of the Slickrock Creek base flow in Alternatives WM2 and WM3 will require minor modifications to the construction of the HDS treatment facility. The modifications to the HDS treatment process are readily implementable because they involve only flow control,

treatment, and existing sludge disposal facilities. All of these facilities involve well established technologies with known costs, effectiveness, and reliability.

Alternative WM3 would explore and secure options to guarantee the availability of water to ensure the dilution water for the uncontrolled spills from the existing SCDD through the purchase of necessary rights to the required amounts of water. These options include possible purchase of water from the CVP and from individual holders of water rights. Water right purchasing is a relatively new development in California; therefore, its implementability is uncertain.

Alternatives WM4 and SR1 propose standard construction and treatment processes, dam construction, and HDS treatment. The implementability of these alternatives is complicated by the difficult Site conditions, such as the narrow ravines and lack of relatively flat terrain. These Site features will complicate the design, construction, and maintenance of the dams, diversions, roads, pipelines, and treatment plant modifications. Operation of the treatment plant to treat all contaminated runoff during storms is expected to be difficult and challenging. The existing SCR provides a backup for episodic plant discharges of untreated waters. The Boulder Creek Remedial Alternatives Study indicates that response actions for Boulder Creek area sources would be implementable. The appropriateness and feasibility of responding to other sources (including but not limited to contaminated stream sediments) could be evaluated in a further remedial investigation and feasibility study, if necessary.

Table 7 below presents a comparison of each alternative's ability to meet this criterion.

TABLE 7
Summary of Implementability
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
Alternative WM0–No Further Action.	Readily implementable.
Alternative WM1–Enlarge SCR to 15,000 acre-feet and dilute uncontrolled spill water, if dilution water is available.	Readily implemented, as it uses well established technologies with known costs, effectiveness, and reliability. All materials and work force are readily available. Administrative implementability is straightforward.
Alternative WM2–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water, if dilution water is available.	Readily implemented, as it uses well established technologies with known costs, effectiveness, and reliability. All materials and work force are readily available. Administrative implementability is straightforward.

TABLE 7
Summary of Implementability
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Component
Alternative WM3–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water with purchased dilution water.	Readily implemented, as it uses well established technologies with known costs, effectiveness, and reliability. All materials and work force are readily available. Administrative implementability is straightforward. Securing of water rights is uncertain and may not be implementable.
Alternative WM4–Rely on the existing SCDD as backup for plant failures, build two alternative dams (one in Slickrock Creek and one in Boulder Creek), build clean-water diversions, and collect and treat all contaminated water.	Readily implemented, as it uses well established technologies with known costs, effectiveness, and reliability. All materials and work force are readily available. Administrative implementability is straightforward. Site conditions will complicate the implementation of dams. Stormwater treatment may present operational difficulties.
Alternative SR1–Construct a dam in Slickrock Creek and clean-water diversions, collect and treat all contaminated Slickrock Creek runoff, and build a retaining structure for the hematite pile.	Readily implemented, as it uses well established technologies with known costs, effectiveness, and reliability. All materials and work force are readily available. Administrative implementability is straightforward. Site conditions will complicate the implementation of dams. Stormwater treatment may present operational difficulties. Alternative SR1 can later be combined with an appropriate area source remedial alternative for Boulder Creek (such as those developed and evaluated in EPA's Boulder Creek Remedial Alternatives Study). The implementability of an alternative that combines SR1 with a subsequent Boulder Creek remedy would be similar. Implementability of other responses would be evaluated in subsequent investigations, if necessary.

VIII.7 Criterion 7—Cost

This criterion examines the estimated costs for each remedial alternative.

Table 8 below presents estimates of the 30-year present worth for each alternative. The table shows the initial capital investment, the initial annual operations and maintenance costs, the present worth of 30 years of operation (at 5 percent interest rate), and the total 30-year cost. The 30-year basis is selected to compare the costs of the alternatives, but remediation is expected to continue beyond 30 years.

TABLE 8
Summary of Cost
Record of Decision 1997, Iron Mountain Mine Superfund Site

Alternative	Total Capital Costs ($ x 1,000)	Total Annual O&M Costs ($ x 1,000)	Present Worth O&M Costs ($ x 1,000)	Total 30-Year Present Worth ($ x 1,000)
Alternative WM0–No Further Action.	0	0	0	0
Alternative WM1–Enlarge SCR to 15,000 acre-feet and dilute uncontrolled spill water, if dilution water is available.	74,240	60	922	75,162
Alternative WM2–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water, if dilution water is available.	77,531	273	4,196	81,727
Alternative WM3–Enlarge SCR to 15,000 acre-feet, collect and treat the base flow from Slickrock Creek, and dilute uncontrolled spill water with purchased dilution water.	77,531	899	13,816	91,347
Alternative WM4–Rely on the existing SCDD as backup for plant failures, build two alternative dams (one in Slickrock Creek and one in Boulder Creek), build clean-water diversions, and collect and treat all contaminated water.	116,215	928	14,271	130,486
Alternative SR1–Construct a dam in Slickrock Creek and clean-water diversions, collect and treat all contaminated Slickrock Creek runoff, and build a retaining structure for the hematite pile.	18,709	160	2,460	21,169
Most expensive Boulder Creek alternative developed to date	*30,374*	*320*	*4,920*	*35,294*
SR1 combined with most expensive Boulder Creek alternative developed to date	*49,083*	*480*	*7,380*	*56,943*

Alternative SR1 can later be combined with an area source remedial alternative for Boulder Creek. For purposes of cost comparisons between SR1 and other sitewide remedies, this analysis relies on Alternative No. 2H, Combined Area Source Alternative, as the appropriate

Boulder Creek remedy. That remedy is the most costly feasible alternative considered in the Boulder Creek Remedial Alternatives Study. Even when combined with the most expensive remedy for Boulder Creek area sources, Alternative SR1 provides the most cost-effective response to sitewide releases.

In general, these cost estimates are the product of the "order-of-magnitude" estimating procedures based upon conceptual layouts and preliminary cost information. Estimates of this nature are subject to changes as more detailed engineering and cost information becomes available. It is commonly assumed that actual cost may vary from the stated amounts by as much as +50 percent to -30 percent. Cost information for the enlargement of the SCDD would be significantly more reliable because of the more detailed studies conducted by EPA on that issue.

The costs shown for the alternatives do not include costs associated with future reliance on the existing SCDD to provide emergency storage during treatment plant failures or any other use of the existing SCDD. The cost of continued SCDD operations is comparable to the No-Action Alternative, which is assumed to have a cost of zero for purposes of the comparative analysis.

VIII.8 Criterion 8—State Acceptance

State acceptance refers to the State's position and key concerns related to the preferred alternative and other alternatives, and State comments on ARARs or the proposed use of waivers.

Throughout the development of this operable unit, EPA has worked closely with the California Department of Toxic Substances Control (DTSC) (the State lead agency), RWQCB, and CDFG. All three agencies support the selection of Alternative SR1 as described in the May 1996 Water Management FSA.

VIII.9 Criterion 9—Community Acceptance

This criterion refers to the community's stated preferences through oral and written comments on EPA's Proposed Plan regarding which components of the alternatives interested persons in the community support, have reservations about, or oppose.

There was significant community interest in EPA's June 1994 and May 1996 Proposed Plans. The public meeting held in connection with the May 1996 Proposed Plan was attended by approximately 25 people. The general public did not submit any comments on the May 1996 Proposed Plan, but comments submitted in connection with the May 1994 Proposed Plan expressed overwhelming support in favor of taking immediate action at the Site. In the context of the 1994 Proposed Plan, several community members supported onsite treatment in lieu of enlarging the SCDD. Prior comments from the community also supported the use of the inactive open pit mine, Brick Flat Pit, for sludge disposal.

Rhone-Poulenc submitted detailed comments in support of its conclusion that no further action is warranted at this time. If EPA selected additional response action, Rhone-Poulenc urged EPA to select treatment of Slickrock Creek baseflows. Rhone-Poulenc recently requested that EPA defer remedy selection to permit Rhone-Poulenc to investigate the feasibility and effectiveness of implementing limited surface-water collection in the Big Seep

area of Slickrock Creek and a groundwater collection program that would rely on intercept trenches to collect limited groundwater from Slickrock Creek area sources.

IMMI did not submit any comments on EPA's 1996 Proposed Plan.

Responses to the above comments are presented in the Response to Comments document.

IX. THE SELECTED REMEDY

The EPA is selecting Alternative SR1 as described in the May 1996 Water Management FSA. The selected remedy incorporates a retention dam within the Slickrock Creek drainage, a clean water diversion system, and upgrades to the pipeline and treatment plant. The selected remedy relies on the collection and treatment of the AMD-contaminated surface-water discharges from the area sources in the Slickrock Creek watershed that discharge to the reach of Slickrock Creek below the heavily disturbed mining area. The remedy, as finally designed and implemented, may rely to some extent on source control of specific sources and on water management technologies to ensure collection of the contaminated surface flows as well as to minimize the amount of water that could become contaminated by the area source discharges and require treatment (such as a collection system for seeps under the hematite pile and the flows from Brick Flat Pit).

The major components of the selected remedy include:

- Construct a retention dam and necessary surface water diversion facilities to ensure the collection and storage of contaminated surface runoff, interflow, and groundwater in the Slickrock Creek watershed at IMM.

- Construct facilities to provide controlled release of contaminated waters from the retention dam to the AMD conveyance pipeline to the IMM HDS/ASM lime neutralization treatment plant.

- Construct facilities to divert relatively uncontaminated surface water from the area upstream from the highly disturbed mining area of the Slickrock Creek basin and divert that water around the Slickrock Creek retention reservoir. The diversion shall also divert around the retention reservoir the water from the unmined side of the Slickrock Creek watershed.

- Take appropriate steps (including consideration of emergency failure scenarios) to integrate into the operation of the reservoir the collection and conveyance of the Old/No. 8 Mine Seep AMD to the IMM HDS/ASM lime neutralization treatment plant.

- Construct a hematite erosion control structure consistent with California mining waste requirements.

- Construct one or more sedimentation basin(s) or other EPA approved control structures in the Slickrock Creek watershed to minimize sedimentation of the Slickrock Creek retention reservoir and to ensure proper functioning of the controlled release facilities.

- Upgrade the hydraulic capacity of the existing pipeline (or if necessary construct a new pipeline) from Slickrock Creek to the Boulder Creek crossing as required to ensure adequate reliable capacity to convey Slickrock Creek and Old/No. 8 Mine Seep AMD.

- Construct an additional pipeline to reliably convey Slickrock Creek and Old/No. 8 Mine Seep AMD from the Boulder Creek Crossing to the IMM HDS/ASM lime neutralization treatment plant.

- Modify the IMM HDS/ASM lime neutralization treatment plant to ensure proper treatment, using the HDS/ASM treatment process, of the Slickrock Creek area source AMD discharges in conjunction with AMD flows collected pursuant to other Records of Decision.

- Construct a tunnel to provide for gravity discharge of the high volumes of effluent from the IMM HDS/ASM treatment plant to Spring Creek below the Upper Spring Creek diversion to Flat Creek.

- Construct facilities to assure collection of significant identified sources (including but not limited to seeps from Brick Flat Pit and the hematite piles) and convey those releases to the Slickrock Creek Retention Reservoir.

- Perform long-term operations and maintenance (O&M) of all components.

X. STATUTORY DETERMINATIONS

The EPA's primary responsibility at Superfund sites is to select remedial actions that are protective of human health and the environment. CERCLA also requires that the selected remedial action for the Site comply with applicable or relevant and appropriate environmental standards established under Federal and State environmental laws, unless a waiver is granted for a particular ARAR. The selected remedy must also use permanent treatment technologies or resource recovery technologies to the maximum extent practicable and be cost-effective. The statute also contains a preference for remedies that include treatment as a principal element. The following sections discuss how the selected remedy meets these statutory requirements.

X.1 Protection of Human Health and the Environment

The selected remedy protects human health and the environment from the exposure pathways that are being addressed in this interim action. The selected remedy addresses IMM AMD releases from essentially all of Slickrock Creek area sources and the hematite pile. The alternative will permit treatment of essentially all of the IMM AMD from the Slickrock Creek area sources, which comprise approximately 60 to 70 percent of the remaining uncontrolled copper and 40 to 50 percent of the remaining uncontrolled zinc and cadmium releases from IMM. These collected releases will be treated to neutralize the acidity of the water and remove more than 99 percent of the metals. The concentrations in the contaminated Spring Creek watershed would be expected to decrease proportionately under all hydrologic

conditions. The remedy will also control releases from the hematite pile. The selected remedy is an interim remedy that is not expected to be final and does not address all of the sources of discharges from the Site. The selected remedy therefore cannot be expected to be fully protective of human health and the environment.

The primary human health-related exposure pathway is the ingestion of contaminated surface waters. The selected remedy would ensure that State and Federal drinking water standards are not exceeded at the point of withdrawal for the Redding Municipal Water District, except during extreme spill events. The alternative will improve water quality in the creeks draining Iron Mountain, in SCR, and in the lower portion of Keswick Reservoir, but the remedy will not ensure compliance with human health standards in these water bodies. The human health threat posed by potential exposure to contaminated sediments through ingestion is not addressed by the selected remedy. However, control of the hematite pile will reduce the release of airborne arsenic into the environment.

The environmental threats posed by these sources are the very significant releases of copper, cadmium, zinc, and acidity into surface waters. The selected remedy will essentially eliminate the discharges from the sources being addressed in this interim action. The removal of these metal loads associated with the Slickrock Creek area sources will significantly improve the surface water quality below the SCDD and provide significant protection to aquatic resources below Keswick Dam. The metal removal will decrease the frequency, duration, and toxicity of SCDD spills of IMM AMD, make significant progress toward the attainment of appropriate water quality criteria in and below Keswick Reservoir, and provide some improvement in receiving waters above the SCDD.

The removal of metals will make significant progress toward compliance with the SBPS and the PCTR in the Spring Creek arm of the Keswick Reservoir. Currently, water quality criteria in that water body are exceeded on a regular basis, and only limited beneficial uses are attainable under current conditions.

The anticipated reduction in SCDD spill frequency associated with the selected remedy is not as great as Alternatives WM1, WM2, WM3, and WM4; however, the spills occurring after implementation of the selected remedy will tend to be less toxic and require less dilution because the SCR water will contain lower concentrations of metals. When combined with a remedy for the Boulder Creek area sources (to be the subject of additional study and a later EPA decision), the selected remedy could potentially be comparable to the other alternatives with respect to reducing SCDD spills and protecting the environment below SCDD.

The current uncontrolled IMM area source AMD discharges are estimated to result in SCR waters with copper concentrations of approximately 400 to 800 ppb, and zinc concentrations of approximately 600 to 1,200 ppb. The selected remedy is expected to decrease the SCR water concentrations in proportion to the load reduction to approximately 150 to 250 ppb copper and 300 to 600 ppb zinc (with similar proportional reductions for cadmium). Although less polluted than current conditions, these levels will remain well in excess of the existing standards for copper (5.6 ppb) and zinc (16 ppb). Since the water will be less contaminated, the water will require less dilution to meet protective standards, so the SCR waters could generally be discharged from the SCR under controlled conditions at higher

rates than the current discharge. The ability to discharge greater quantities of water creates a greater capacity to manage the discharge of the large flows of contaminated stormwaters. This greater water management capability reduces the frequency of uncontrolled spills from SCDD, which in turn reduces the frequency of SBPS and PCTR exceedances below Keswick Dam.

Water quality modeling using the most recently acquired data indicates that the selected remedy will provide significant additional protection to the environment. The model takes into account all the remedial actions implemented to date and calculates the frequency at which the SBPS and the PCTR would be exceeded in the main stem of the Sacramento River below Keswick Dam over the 31-year study period (1965 to 1995). The model is capable of taking into account the uncertainties inherent in real-time operation of CVP facilities. For the modeling conducted in 1996, EPA generally assumed that these uncertainties could be accounted for by targeting SCDD operations to meet a value equal to 75 percent of the actual standard. Comments submitted by the USBR indicate that this assumption might be overly optimistic, which would cause the model to understate the frequency and duration of exceedances. Since 1996, EPA has conducted additional analysis of the difficulties inherent in trying to predict metal concentrations below the SCDD in real-time under highly variable conditions. This additional investigation indicates that, even if significant resources are expended to perform an intensive monitoring program and make frequent operational adjustments, achieving a 75 percent SCDD operational efficiency under all conditions could be an overly optimistic assumption. EPA therefore considers a range of operational efficiencies in evaluating the probability of future SCDD spills under variable hydrologic conditions, including a straight 75 percent assumption and a split operational efficiency that varies the assumed efficiency from 50 to 75 percent depending on the SCR inflows (75 percent is used for SCR inflows less than 50 cfs and 50 percent is used for SCR inflows greater than 50 cfs).

Considering concentration and flow information developed since 1994 and a range of SCDD operation efficiencies indicates that, in the absence of further remediation, uncontrolled spills of IMM contaminants would continue to occur every 3 to 4 years if the SCR is operated to target the SBPS below Keswick Dam and every 2 to 3 years if the SCR is operated to target the PCTR below Keswick Dam. Implementing Alternative SR1 would reduce the expected SCDD spill frequency to once every 8 to 10 years if the SCR is operated to target the SBPS below Keswick Dam and every 4 to 8 years if the SCR is operated to target the PCTR below Keswick Dam. Alternative SR1 is also expected to decrease by approximately 80 percent the days that the Sacramento River below Keswick Dam experiences a violation of a water quality criteria. See responses to comments in the technical memorandum responding to the *Evaluation of Revised IMM Water Quality Model and its Application to Slickrock Creek Remediation*, by Spaulding Environmental, dated July 1, 1996 and *Additional Water Quality Model Simulations Using Data Collected Through June 1997 and Proposed Water Quality Standards*. The Alternative is also expected to improve water quality in Keswick Reservoir, part of which currently experiences exceedances of the SBPS and PCTR for much of each wet season.

The selected remedy would also protect the environment by significantly reducing the mass loads of copper, cadmium, and zinc through removal of approximately 60 to 70 percent of the remaining uncontrolled copper and 40 to 50 percent of the remaining uncontrolled zinc and cadmium Site discharges. The release of these metals causes heavy metal precipitates to form in the water column, some of which settle in the SCAKR and the Sacramento River below Keswick Dam. The heavy metal-laden precipitates threaten the environment through the physical processes of settling, which could smother benthic organisms, and the inherent toxicity of the heavy metal-laden sediments and the associated pore water (i.e., water in the space in between sediment particles) to benthic organisms. These releases also interfere with remediation of the heavy metal-laden sediments currently in place in SCAKR and other State waters (by continuing the introduction of new sediments on a regular basis). Remediation of these sediments could allow for the restoration of beneficial uses for the affected water bodies which would eliminate the threat of releases of toxic metals through mobilization of the sediments.

The selected remedy also protects the environment from the releases being addressed by improving water quality in Spring Creek and Slickrock Creek. While it is too early to determine the extent to which beneficial uses could be fully restored to those waters, removal of these significant metal loads is anticipated to improve the beneficial uses of these impaired waters. Since this is an interim remedy that does not control all releases, however, EPA does not expect that this action will be capable of restoring all beneficial uses to those water bodies.

Reducing metal loads from IMM also produces ancillary environmental benefits by reducing the need for special dilution releases. For example, if special releases of water are required for dilution of IMM AMD, those releases reduce the amounts of water in storage that would otherwise be available for temperature control in the Sacramento River or other environmental needs. An additional ancillary benefit can be realized with reduced reliance on the current use of the Spring Creek Power House discharges to ensure regular flushing of the heavy metals from SCAKR (as described in the USBR Operation Criteria and Plan 1993, pages 44 and 45). Demand for water from the Trinity River and upper Clear Creek would be reduced, increasing its availability for beneficial uses in those watersheds.

As part of the Site investigation, EPA has concluded that Site remedies that rely on the selected remedy as a component are feasible, and can ensure that releases associated with an extreme hydrologic event would be rare.

In summary, current conditions are not protective and do not meet the remedial action objectives for the Site. The implementation of the Slickrock Creek Retention Dam remedial action is not expected to fully meet the remedial action objectives for the Site without further actions, but would significantly reduce the exceedances of the water quality standards and production of toxic sediments. These beneficial effects are expected to significantly improve the protectiveness of the Superfund cleanup.

With respect to this criterion, the selected remedy, in conjunction with a subsequent Boulder Creek remedy, is preferable to Alternatives WM0, WM1, WM2, and WM3. The remedy, which can easily be implemented in conjunction with a Boulder Creek remedy, would

remove a significant amount of heavy metals from the system rather than simply diluting the heavy metal discharges or treating only the Slickrock Creek baseflows. Alternative SR1, in conjunction with an available Boulder Creek remedy, could provide protection approximately equivalent to Alternative WM4, but at less cost.

X.2 Compliance with ARARs

The selected remedy provides for significant progress toward meeting ARARs for the Superfund cleanup action at IMM by reducing the discharges of copper, cadmium, zinc, and acidity from the Site. In particular, the remedy will result in better water quality in the Sacramento River by limiting discharges of copper, cadmium, zinc, and acidity from the Site, thereby reducing the number of days and/or the degree of exceedances of the State Basin Plan standards (and the PCTR) in the Sacramento River and Keswick Reservoir. This section discusses the ARARs which the action will meet and identifies the ARARs which are being waived.

The Slickrock Creek area discharges are similar in nature and characteristics to the IMM AMD sources addressed in the September 30, 1992, Record of Decision for the Boulder Creek Operable Unit at IMM. The September 30, 1992, Record of Decision thoroughly discusses the ARARs for this type of source (AMD containing high concentrations of copper, cadmium, and zinc) and ARARs for the selected remedy (treatment with onsite sludge disposal or discharge of the treated effluent to lower Spring Creek and waste pile management). The September 30, 1992, Record of Decision discussion regarding ARARs in Section X.2 is incorporated fully by reference, except as modified below.

Compliance with Chemical-Specific ARARs

The selected remedy makes significant progress toward complying with chemical-specific ARARs below Keswick Dam, but the remedy does not ensure compliance with the SBPS under all circumstances and in all locations. The reduction in the IMM metal discharges would significantly increase compliance with the SBPS in the Sacramento River except in unusual circumstances. The treatment plant will continue to meet the effluent standards as set forth in the 1992 ROD.

The selected remedy would improve water quality in Keswick Reservoir but would not assure compliance with the SBPS under all circumstances. Combining the selected remedy with an available Boulder Creek Remedy could potentially attain compliance with the ARARs for Keswick Reservoir.

In the 1992 ROD, EPA identified the California Inland Surface Waters Plan as an ARAR. Since that time, the plan has been held to be invalid on procedural grounds, so the standards are not ARARs for this response action. Once the plan was invalidated, California no longer had statewide numeric water quality criteria. On August 5, 1997, EPA promulgated the PCTR, which are draft statewide water quality criteria for California (62 Federal Register 42160 [1997]). If adopted, the standards would apply to subsequent response actions at IMM to the extent the standards are more stringent than the SBPS. Because the SBPS do not currently have a 96-hour standard (the SBPS are stated as instantaneous maximums), the PCTR would likely serve as that standard. As discussed above, the selected remedy will

make significant progress toward enabling management of Site discharges in a manner that would comply with the PCTR.

The selected remedy does not ensure compliance with the SBPS or PCTR above the SCDD, and continuous exceedances in those bodies are expected to remain even after implementation of Alternative SR1. Since Alternative SR1 removes significant metal loads from Slickrock Creek, some of the beneficial uses of that stream could potentially be restored over time (particularly if additional steps are taken to address the remaining sources in that watershed).

The disposal of sludge from the treatment effluent would be required to meet State standards applicable to mining waste. Sludge from treatment of the Slickrock Creek contaminated waters would be disposed of in the onsite landfill constructed pursuant to ROD2 and ROD3. The disposal facility was constructed in accordance with the State standards for disposal of mining wastes.

Compliance with Location-Specific ARARs

The selected remedy shall address and comply with all location-specific ARARs. Significant action-specific ARARs include those relating to disposal of treatment sludge and ARARs directing activity to protect affected fisheries, aquatic resources and their habitat.

The action would need to comply with the substantive requirements of the Fish and Wildlife Coordination Act because the action will result in the regular inundation of an area on the mine property. Areas that would be unavoidably impacted by the selected remedy include chaparral and riparian habitat that is currently significantly impaired because the area is highly disturbed by past mining activity. The EPA will consult with the USFWS to develop appropriate mitigation measures.

The requirements for protection of habitat in the Endangered Species Act are also ARARs for this action. The selected remedy would have a potential impact on a federally endangered species because the action would reduce the toxic releases from IMM that threaten the winter-run chinook salmon. Although it is anticipated that such impacts will be beneficial and would further the goals of the Endangered Species Act, EPA has been consulting with the NMFS in accordance with the provisions of the Endangered Species Act. The EPA has also worked closely with the appropriate Natural Resource Trustees to ensure protection of natural resources.

This action will not impact archaeological and/or historic sites of significance.

Compliance with Action-Specific ARARs

The selected remedy shall address and is expected to comply with all action-specific ARARs. The action would have a potential impact on a federally endangered species. Although it is anticipated that such impacts would be beneficial, EPA has been coordinating the development and evaluation of potential IMM remedial actions with the Federal and State Natural Resource Trustees. Consistent with the provisions of the Endangered Species Act, EPA has been consulting with the NMFS regarding proposed remedial actions for the Site.

In prior actions, the State of California has identified State requirements for seismic safety as requirements for construction projects generally (see CDFG letter of March 27, 1992). The Dam Safety Act also serves as an ARAR for the construction of any dam, including the dam to be constructed as part of this response action. (See DTSC and RWQCB letter of March 30, 1992).

The selected remedy involves control of the large hematite pile located in the Slickrock Creek watershed. The inactive mining waste unit shall be controlled in the manner required by the California Mining Waste Requirements identified in the 1992 ROD.

ARAR Waivers

The EPA is waiving compliance with certain ARARs on the basis that this proposed action is an interim action that will not respond to all releases of hazardous substances from the facility. Since the dam and treat interim remedial action for the Slickrock Creek area source AMD discharges does not address releases other than area sources discharging to the reach of Slickrock Creek below the heavily disturbed mining area, such as releases from area sources in the Boulder Creek watershed and the existing sediments in SCR and Keswick Reservoir, this interim action is not expected to provide for compliance with all ARARs at all times. Since the action selected in this Record of Decision is an interim action that leaves some releases of hazardous substances unabated, EPA is relying on the ARARs waiver for "interim measures" (CERCLA § 121(d)(4)(A); 40 CFR § 300.430(f)(1)(ii)(C)(1)) for this remedial action. That section provides that ARARs may be waived if "the remedial action selected is only part of a total remediation that will attain such level or standards of control when completed."

The EPA anticipates that the remedy will improve water quality in Spring Creek, Spring Creek Reservoir, Keswick Reservoir, and the Sacramento River, but EPA does not anticipate that this remedy, in conjunction the other remedies implemented to date, will be sufficient to ensure compliance with (1) the numeric, chemical-specific standards contained in the SBPS for copper, cadmium, or zinc, and (2) California Fish and Game Code § 5650 (which prohibits discharge of contaminants "deleterious to fish, plant life, or bird life"). The EPA is therefore waiving compliance with those standards for the interim action to the extent those standards cannot be achieved by the remedy selected in this Record of Decision in conjunction with the remedies implemented under prior RODs.

The EPA anticipates that a permanent waiver for certain ARARs might ultimately be required for certain receiving waters above the SCDD, but EPA is deferring a final decision until additional information is known regarding the feasibility and degree to which some beneficial uses could be restored to those water bodies.

X.3 Cost-Effectiveness

Section 300.430(f)(1)(ii)(D) of the NCP requires EPA to evaluate cost-effectiveness by comparing the alternatives that meet the threshold criteria against three additional balancing criteria: long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness. The selected remedy is cost-effective with respect to meeting these criteria.

The total cost of the selected remedy (including both the capital and O&M costs based on a 30-year present worth cost using a 5 percent interest rate) is estimated to be about $21,169,000. Since EPA has not yet addressed further Boulder Creek remedial actions or continued SCDD operations as part of the selected remedy, the costs described above for implementation of the selected remedy do not include the expected costs associated with potential remedies for the Boulder Creek area sources or continued operation of SCDD.

To more fully evaluate the cost-effectiveness of the selected remedy, EPA considered the cost of combining the selected remedy with the most expensive technically feasible Boulder Creek remedy from EPA's Boulder Creek Alternatives Study (which is referred to below as the Combined Alternative SR1). The 30-year present worth cost of the Combined Alternative SR1 is estimated to be less than $57 million. (EPA is still investigating the appropriate response action for Boulder Creek area sources, so the response action for those sources could be greater or less than the amount used in this analysis.) The Combined Alternative SR1 is less costly than the other remedial alternatives, which range in cost from approximately $75 million to approximately $130 million. As discussed above, this combined remedy would provide a response action that is at least equivalent to the other remedies with respect to (1) long-term effectiveness and permanence; (2) reduction of toxicity, mobility, or volume through treatment; and (3) short-term effectiveness. The selected remedy is therefore a cost-effective component of the overall response action.

The cost estimates for these alternatives do not include the cost of continuing to operate the SCDD as a component of the remedies because the cost of continued SCDD operations is comparable to the No-Action Alternative, which is assumed to have a cost of zero for purposes of the comparative analysis.

X.4 Utilization of Permanent Solutions and Alternative Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be employed in a cost-effective manner for the interim remedial action.

The EPA recognizes that the mineralization at IMM will continue to generate AMD unless additional remedial actions are developed, evaluated, and selected for implementation to reduce or eliminate the AMD-forming reactions. The EPA has developed and evaluated alternatives as part of the ongoing remedial investigation and feasibility study activities at IMM that could reduce or eliminate the AMD-forming reactions. Resource recovery alternatives have also been proposed and evaluated. The EPA has concluded that further information is required to be developed and evaluated before one of these approaches could be selected for implementation. The needed further information would address technical feasibility, implementability, effectiveness, and cost-effectiveness concerns and risk factors with respect to these approaches. The EPA encourages the further development of alternatives that could control the AMD-forming reactions and resource recovery alternatives for future evaluation and potential selection in a subsequent action.

The selected remedy will provide for a significant reduction in the copper, cadmium, zinc, and acidity discharges from the Site. The current water supply and fishery conditions are

critical. There is a need to implement controls on these discharges as expeditiously as possible, while studies are ongoing with respect to further source control or resource recovery approaches. Treatment is effective, a part of each approach developed to date, and is consistent with implementation of a subsequent action.

X.5 Preference for Treatment as a Principal Element

The selected remedy relies on treatment as a primary component to reduce the toxicity and mobility of the AMD which is being generated. The HDS neutralization treatment process is expected to be very effective in preventing the discharge of metals from the Slickrock Creek contaminated flows that are collected and conveyed to the treatment plant for treatment. The HDS neutralization process is expected to remove more than 99 percent of the metals from the treated contaminated Slickrock Creek flows.

The EPA is not selecting a remedy that treats the source in a manner that prevents the formation of AMD because EPA is not currently aware of such an approach that could be effectively implemented at IMM. The EPA encourages the continued development and evaluation of alternatives that may partially satisfy the preference for treatment as a principal element, and this issue will be addressed in the final decision document for the Site. The EPA has concluded that further development and evaluation of the above approaches is necessary to address significant uncertainties with respect to technical feasibility, implementability, effectiveness, cost-effectiveness concerns, and risk factors.

XI. DOCUMENTATION OF SIGNIFICANT CHANGES

The EPA is today approving the Proposed Plan with no significant changes.

ERRATA NOTICE

RECORD OF DECISION
IRON MOUNTAIN MINE
SLICKROCK CREEK AREA SOURCE REMEDY

This document reflects minor clerical corrections made pursuant to the October 9, 1997 Decision Memorandum signed by Keith A. Takata.

ATTACHMENT "B"

Attachment B to Administrative Order No. 97-16 for Remedial Design, Remedial Action, Operation and Maintenance

Scope of Work
Iron Mountain Mine
Slickrock Creek Area
Remedial Design/Remedial Action

ATTACHMENT B
SCOPE OF WORK
IRON MOUNTAIN MINE
SLICKROCK CREEK AREA
REMEDIAL DESIGN/REMEDIAL ACTION

SCOPE OF WORK
IRON MOUNTAIN MINE
SLICKROCK CREEK AREA
REMEDIAL DESIGN/REMEDIAL ACTION

1.0 INTRODUCTION AND OBJECTIVES

1.1 Introduction

This Scope of Work (SOW) details the activities to be undertaken by the Respondents in compliance with this Order 97-16 at the Iron Mountain Mine (IMM) site.

The Work includes all activities necessary for the design, construction, compliance testing, and operation and maintenance (O&M) of Slickrock Creek area source collection and treatment facilities. The Work also includes the development and implementation of management plans and coordination procedures. The overall objective is to design, construct, operate, and maintain a system to perform the following:

- Collect the area source acid mine drainage (AMD) runoff from the contaminated areas of the Slickrock Creek watershed;
- Divert uncontaminated water from areas of Slickrock Creek above the influence of mining activity in the vicinity of the Catfish Pond and undisturbed areas on the south side of the Slickrock Creek watershed.
- Convey the Slickrock Creek area source AMD runoff to the IMM HDS/ASM lime neutralization treatment Plant at Minnesota Flats;
- Prevent or minimize the discharge of sediment to conveyance pipelines and downstream equipment;
- Prevent the discharge of Hematite to Slickrock Creek, consistent with California mining waste requirements;
- Modify the existing Minnesota Flats Treatment Plant to enable the plant to treat the combined AMD flows from the Richmond Portal, Lawson Portal and Old/No. 8 Mine Seep and the Slickrock Creek area source AMD runoff using the HDS/ASM treatment processes;
- Discharge treated water to Lower Spring Creek by gravity; and

- Conduct O&M activities during construction, during performance testing, and subsequent to these phases in accordance with procedures described in this SOW.

1.2 Basic Elements of Work Overview

The Work shall be divided into three major work components: The Slickrock Creek Retention Reservoir, the AMD Conveyance Modifications, and the Minnesota Flats Treatment Plant modifications. Each of these major components will be divided into subcomponents as described below:

1.2.1 The Slickrock Creek Retention Reservoir work shall include the following Subcomponents:

- **Retention Dam**: Design, construct, operate and maintain a retention dam in Slickrock Creek, including the embankment, spillway, outlet works, and necessary appurtenances.

- **Hematite Retention Structure**: Design, construct, operate and maintain facilities that stabilize and contain the Hematite tailings piles adjacent to and in the Slickrock Creek watershed to prevent discharge of Hematite and to prevent damage to the Slickrock Creek retention dam and appurtenances;

- **Sediment and Debris Basin(s) or Control Structures**: Design, construct, operate and maintain sediment and debris basin(s) or control structure(s) to prevent or minimize the load of sediment and/or debris discharged into the Slickrock Creek Retention Reservoir and to the AMD conveyance system; and

- **Clean Water Diversions**: Design, construct, operate and maintain Clean Water Diversions to divert uncontaminated water from areas of Slickrock Creek above the influence of mining activity in the vicinity of the Catfish Pond and undisturbed areas on the south side of the Slickrock Creek watershed.

1.2.2 The AMD Conveyance Modification work shall include the following Subcomponent(s):

- **AMD Conveyance System - Slickrock Creek Retention Reservoir to Boulder Creek Crossing**: Design, construct, operate and maintain an AMD conveyance system from the Slickrock Creek Retention Reservoir to the Boulder Creek Crossing. This subcomponent includes: 1) conveying all AMD contaminated runoff from areas of the Slickrock Creek watershed that is collected in the Slickrock Creek Retention

Reservoir from the outlet works of the retention dam to the Boulder Creek Crossing; 2) conveying all AMD from the Old/No. 8 Mine Seep to the Boulder Creek Crossing; 3) stabilizing and relocating access roads and utilities; and 4) constructing all other facilities and performing all other activities necessary to assure the conveyance of all of the collected Slickrock Creek area source AMD flows and the AMD flows from the Old/No. 8 Mine Seep. The conveyance system for this segment of the overall AMD conveyance system shall provide for delivery of all base flows, sustained elevated flows, and peak AMD flows (100-year 3-day storm, ANSI III conditions) from the Slickrock Creek Retention Reservoir and the Old/ No. 8 Mine Seep. The design concept for this segment of the overall AMD conveyance system may rely on the use of portions of the existing AMD conveyance system provided that Respondents submit: 1) an engineering analysis that demonstrates that the existing pipeline (with necessary modifications) would have sufficient hydraulic capacity to convey all AMD flows from the Slickrock Creek Retention Reservoir to the Boulder Creek Crossing; and 2) an analysis that demonstrates that the existing pipeline alignment is stable.

- **AMD Conveyance System - Boulder Creek Crossing to Minnesota Flats Treatment Plant**: Design, construct, operate and maintain an AMD conveyance system that receives the AMD flows from the Slickrock Creek watershed conveyed to this point, and then conveys the AMD flows from the Boulder Creek Crossing to the Minnesota Flats Treatment Plant for treatment. Preliminary engineering analysis indicates that the existing pipeline in this segment, which currently conveys the the AMD discharges from the Richmond Portal, Lawson Portal and Old/No. 8 Mine Seep does not have sufficient hydraulic capacity to convey the additional high volume Slickrock Creek area source AMD discharges. EPA's preliminary design concept includes the construction of an additional pipeline that would be sized to convey the Slickrock Creek area source AMD flows and the comingled AMD flows from the Old/No. 8 Mine Seep. The existing pipeline would be relied on to convey the AMD discharges from the Richmond and Lawson Portals. This existing pipeline would not require modification. Under this conceptual approach, this subcomponent includes: 1) conveying all Slickrock Creek area source AMD flows and the AMD flows from the Old/No. 8 Mine Seep in a newly constructed pipeline from the junction with the Slickrock Creek pipeline at the Boulder Creek Crossing to the Minnesota Flats treatment plant for treatment; and 2) constructing all other facilities and performing all other activities necessary to assure the conveyance of all of the Slickrock Creek area source AMD flows and the AMD flows from the Old/No. 8 Mine Seep from the Boulder Creek Crossing to the Minnesota Flats treatment plant for treatment. The conveyance system for this segment of the overall AMD conveyance system shall provide for delivery of all base flows, sustained elevated flows, and peak AMD flows (100-year 3-day storm, ANSI III conditions) from the Slickrock Creek Retention Reservoir and the Old/ No. 8 Mine Seep.

1.2.3 The Minnesota Flats Treatment Plant Modification work shall include the following Subcomponents:

- **Minnesota Flats Treatment Plant Modifications**: Design, construct, operate and maintain the modifications necessary to permit the IMM High Density Sludge/Aerated Simple Mix (HDS/ASM) lime neutralization treatment plant located at Minnesota Flats to treat the combined peak flows from the Slickrock Creek Retention Reservoir, the Richmond and Lawson portals and the Old No. 8 Mine Seep. The Work shall also include the operation and maintenance of the modified IMM HDS/ASM lime neutralization treatment plant to assure the treatment of all combined AMD flows from the Slickrock Creek Retention Reservoir, the Richmond and Lawson portals and the Old/No. 8 Mine Seep. The Work shall also include the onsite disposal of treatment residuals in the disposal facility constructed pursuant to previous actions in the inactive open pit mine, Brick Flat Pit.

- **Treated Water Discharge System**: Design, construct, operate and maintain: 1) a tunnel to discharge treated water from the IMM HDS/ASM lime neutralization treatment plant to Lower Spring Creek by gravity; 2) a new thickener overflow drop box; and 3) associated piping and appurtenances.

2.0 BACKGROUND

2.1 Remedy Background

On September 30, 1997, the United States Environmental Protection Agency (EPA) selected an interim remedial action for sources of hazardous substance releases at the IMM site, which is located in Shasta County, California, near the City of Redding. This EPA interim remedial action was a Record of Decision (ROD4) that provided a remedy for the Slickrock Creek area source AMD discharges. The selected interim remedial action selected collection of the area source AMD discharges that enter the contaminated reach of Slickrock Creek impacted by extensive mining activity by means of a retention dam, diversion of uncontaminated water around the retention reservoir, conveyance of the collected AMD contaminated runoff to the Minnesota Flats treatment plant, modification of the Minnesota Flats HDS/ASM treatment plant as required, treatment of the collected AMD contaminated runoff with the HDS/ASM process, disposal of treatment sludges onsite in the dispossal facility at Brick Flat Pit, and maintenance of all facilities constructed or modified pursuant to this remedial action. The selected interim remedial action was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

Heavy-metal-laden AMD is released from several and possibly all of the inactive mine workings at IMM and from numerous waste piles on the north side of the Slickrock Creek Basin. IMM AMD discharges to surface waters (which include Slickrock Creek, Spring Creek, the Spring Creek Reservoir, Keswick Reservoir, and the Sacramento River) causing severe environmental impacts and posing a potential threat to human health. The Sacramento River is a major fishery and source of drinking water for Redding. The National Oceanic and Atmospheric Administration (NOAA) has identified the affected area as the most important salmon habitat in the state. Under Clean Water Act 304(1), inventory of impaired water bodies and the point sources affecting the water bodies, EPA identified IMM as the largest such discharger of toxic metals in the United States.

EPA has identified the collection and treatment of the Slickrock Creek area source AMD discharges as a major step in the final remediation of discharges of contamination from the IMM site. Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in ROD4, may present an imminent and substantial endangerment to public health, welfare, or the environment.

3.0 MANAGEMENT PLANS

3.1 Predesign Meeting

The Respondents shall attend a predesign meeting at the Site with EPA, Department of Toxic Substances Control (DTSC, lead agency for the State of California) and California Division of Safety of Dams (DOSOD). The meeting shall be held within ten (10) days of the effective date of this order, and prior to submittal of the Draft Project Delivery Analysis (Draft PDA). The objective of the predesign meeting is to assist Respondents in developing a conceptual understanding of the technical requirements for each remedial action component to be designed, constructed operated and maintained pursuant to this Order for the Site.

The Respondents shall bring to the meeting three (3) copies of all existing data reports, analyses, and any preliminary design or other design work that refer or relate to any component of the Work.

3.2 Project Delivery Analysis

The specific Work to be performed under Order 97-16 and this Scope of Work (SOW) shall be documented by Respondents in a Project Delivery Analysis (PDA) for the design, construction, startup/shakedown testing, operation and maintenance of the structures, equipment and facilities to implement the Remedial Action selected in ROD4. The PDA shall include a step-by-step plan for completing the Remedial Design and Remedial Action for the remedy selected in ROD4 and for attaining and maintaining all requirements, including but not limited to the Performance Standards and project objectives identified in this SOW, ROD4 and all other requirements contained in this Order. The PDA shall describe in detail the tasks and deliverables that Respondents will complete and provide the schedule for completing the tasks and deliverables. The PDA shall include the following:

- Critical path schedule for design and construction, and a schedule for submittal and review of deliverables;
- Work plan for satisfying permitting and other legal requirements;
- Identification and qualifications of the project manager;
- Proposed formulation of the remedial action team;
- Procedures for involving regulatory agencies;
- Procedures for notification of meetings;
- Identification of key meetings; and

- Formats for Engineering Analysis (EA) Reports, Other Reports, and Preliminary, Intermediate, Pre-final, and Final design submittals.

The Respondents shall submit a Draft PDA within twenty-one (21) days from the effective date of the Order. Within seven (7) days immediately following the Respondents' submittal of the Draft PDA, the Respondents shall conduct a meeting with EPA and the State to discuss the draft PDA document and the design issues detailed in Section 4.0, the structure and schedule of future deliverables, and to establish an appropriate schedule for those portions of the Work that must be conducted within an "expedited" time frame.

Within fourteen (14) days of the receipt of EPA's comments on the Draft PDA, Respondents shall revise the Draft PDA to incorporate EPA's comments and submit the revised PDA (Draft Final PDA) to EPA for review and approval. Within seven (7) days from the receipt of EPA approval, the Respondents shall submit the final PDA to EPA. The Final PDA shall be enforceable under this Order.

The PDA and subsequent design documents shall provide the technical details for the implementation of the selected remedial action, remedial action components and sub-components in full accordance with currently accepted environmental protection technologies, standard professional engineering and construction practices, and the requirements of the California DOSOD. The design shall include supporting engineering calculations, clear and comprehensive design plans and specifications. Review and/or approval of design submittals allows Respondents only to proceed to the next step of the design process. Such review and/or approval implies neither acceptance of subsequent design submittals that have not been reviewed, nor that the remedy, when constructed, will meet Performance Standards.

3.3 Health and Safety Plan

The Health and Safety Plan (HASP) shall establish safety, health, and emergency response procedures for all work activities to be conducted by the Respondents. The HASP shall address both workers at the site and public exposure to releases or spills at the site. In accordance with the requirements of Order 97-16, Respondents shall submit an initial HASP prior to initiation of Remedial Design field activities and a second HASP prior to the initiation of Remedial Action field activities. The schedule for submission of these HASPs shall be documented in the PDA. The HASP shall include at least the following basic elements:

- Introduction and purpose;
- Applicable laws and regulations;
- Onsite organization and coordination;

- Medical surveillance program;
- Chemicals of concern;
- Activities hazard analysis;
- Site control, work zones, and security measures;
- General safe work practices;
- Training;
- Personnel protective equipment;
- Procedures for updating and distributing the HASP;
- Recordkeeping;
- Requirements for contractors and subcontractors; and
- Procedures for special activities.

EPA's comments on the HASP shall not constitute EPA approval of the health and safety protocols and other health and safety portions of the HASP.

3.4 Construction Management Plan

Respondents shall develop a Construction Management Plan (CMP) to indicate how the construction activities shall be coordinated during the Remedial Action. Respondents shall designate a person to be its representative on-site during the Remedial Action, and identify this person in the CMP. The CMP shall also identify other key project management personnel and line of authority, and provide descriptions of the duties of the key personnel along with an organizational chart. In addition, a plan for the administration of construction changes and EPA review and approval of those changes shall be included. The CMP shall provide for submittal of Monthly Construction Progress Reports to EPA in accordance with the requirements of Order 97-16 and this SOW. The CMP shall provide for conducting meetings with EPA and State representatives at the conclusion of each major phase of the Remedial Action. The CMP shall also describe the community relations support activities to be conducted during the RA. At EPA's request. Respondents shall assist EPA in preparing and disseminating information to the public regarding the RA work to be performed.

4.0 DESIGN ACTIVITIES - SLICKROCK CREEK RETENTION RESERVOIR

4.1 Dam Structure, Spillway, and Outlet Works

4.1.1 Performance Standards and Objectives

The Respondents shall design the dam structure, spillway, and outlet works in accordance with good engineering practice to achieve the following performance standards and objectives:

- The reservoir shall capture, temporarily store, and provide controlled discharge for treatment of all area source AMD discharges from the contaminated reach of Slickrock Creek (consistent with the formulation of Alternative SR1, EPA 1996 WMFSA, Volume II, Appendix D (1997 AR1426)) and the contaminated Brick Flat Pit (BFP) AMD discharges during a 100-year, 3-day storm event.

- Respondents shall perform, and submit for EPA review and approval, a complete engineering analysis to determine the retention reservoir storage capacity that is necessary (in combination with effective controlled release, conveyance and treatment of the Slickrock Creek area source AMD flows) to assure the treatment of the Slickrock Creek area source AMD flows and contaminated BFP discharges during a 100-year, 3-day storm. This capacity is referred to as the the Protective Reservoir Size or PRS.

  Respondents shall also perform, and submit for EPA review and approval, a complete engineering analysis to determine the reservoir storage capacity needed in addition to the PRS to assure full treatment of the Slickrock Creek area source AMD discharges during equpment failures associated with treatment plant upsets or downtime, pipeline failures or other failures of equipment or facilities during adverse conditions (during a 100-year, 3-day storm) to assure protective emergency storage capacity. This additional capacity is refered to as the Protective Emergency Capacity or PEC.

  Respondents shall determine the 100-year, 3-day storm event criteria using ANSI III conditions.

- The retention reservoir created behind the dam shall have a minimum working capacity of the PRS and a minimum additional emergency storage capacity of PEC. EPA's preliminary analysis indicates that the minimum Slickrock Creek area source AMD retention reservoir capacity would be at least 200 acre-feet, consisting of a minimum PRS of at least 170 acre-feet and a minimum PEC of at at least 30 acre-feet.

- The dam structure, spillway, and outlet works shall be designed in accordance with

generally accepted standards of the engineering profession and in accordance with California DOSOD requirements.

- The retention reservoir and outlet works structures shall be designed and constructed to permit removal of sediment from the reservoir and from the outlet works during all weather conditions.
- All components, facilities, and site changes associated with the construction shall be designed and constructed in a robust manner, ensuring long-term reliable service.
- Access to the reservoir by O&M vehicles shall be ensured under all weather conditions via the Jeep trail and via the existing roadway along the Hematite pile from the main road toward Brick Flat Pit. The top of the dam shall be accessible to O&M vehicles by road.
- The outlet works shall provide for gravity flow of the reservoir discharge to the conveyance pipeline and the IMM HDS/ASM Treatment Plant at Minnesota Flats.
- The outlet works shall consist of a multilevel gated intake structure connected to a discharge pipeline under the dam.
- The intake structure shall be accessible to O&M vehicles from the dam embankment and have a minimum of three multilevel gated outlets.
- Each gate in the outlet works shall be remote controlled and electrically operated with manual handwheel overrides and controlled by a telemetry system that communicates with the treatment plant programmable logic controller (PLC) to provide controlled releases of AMD between zero and a "full-open" discharge capacity for each gate that provides for a minimum discharge of 4,000 gallons per minute (gpm) at the "full-open" setting.
- The manual override shall be constructed so that AMD discharge through the outlet works may be shut off within 15 minutes by a single operator at the dam site.
- The gates shall be constructed so that the discharge flow rate may be controlled within 5 percent of the flow rate selected by the operator. For example, if the operator sets the gates for a 3,000-gpm flow rate, the actual flow rate will be within plus or minus 150 gpm of the intended setting of 3,000-gpm.
- The outlet works shall be designed, constructed and maintained such that the outlet works can readily be cleaned out and maintained.
- The materials of construction shall be acid-resistant and consist of high-density polyethylene (HDPE), Type 316 stainless steel, and other suitable materials as

expressly approved by EPA as a suitable material. The design shall enable ready inspection of components and shall incorporate features allowing ease of access for removal and replacement of all components susceptible to acid degradation, corrosion, or wear.

- The spillway shall be designed to DOSOD requirements.
- The spillway and outlet works shall be founded on bedrock.
- The flow rate through the outlet works, storage in gallons, rainfall, and water level behind the dam shall be measured continuously and displayed both locally and on the Minnesota Flats Treatment Plant PLC.
- HIGH and RATE-OF-CHANGE flow alarms from the dam, and HIGH and HIGH-HIGH level alarms behind the dam shall be provided locally and on the Minnesota Flats Treatment Plant PLC.
- The dam shall be provided with geotechnical instrumentation such as piezometers and settlement monuments.
- All mitigiation required pursuant to the Fish & Wildlife Coordination Act shall be completed.

4.1.2 Engineering Analysis Reports

The Respondents shall develop and provide Engineering Analysis (EA) Reports that describe and present the engineering and geologic aspects of the Slickrock Creek Retention Reservoir and Dam. The reports shall be kept in draft form and modified as additional information is obtained. The reports shall be compatible with the final design. The reports shall not be finalized until EPA has authorized their finalization.

The Respondents shall submit the draft Preliminary Design EA Reports as part of the Preliminary Design Submittal, draft Intermediate Design EA Reports as part of the Intermediate Design submittal, draft Pre-final Design EA Reports as part of the Pre-final Design submittal, and the Final EA Reports as part of the Final Design submittal for this component of the Remedial Action. All Final Design EA Reports shall be approved, sealed, and signed by a Professional Engineer registered in California.

The number of reports shall be determined by the Respondents, but shall include as a minimum the following:

- Reservoir Capacity Study - Respondents shall perform, and submit for EPA review and approval, a complete engineering analysis to determine the reservoir storage capacity that is necessary (in combination with effective controlled release, conveyance and treatment of the Slickrock Creek area source AMD flows) to

provide protective storage capacity that would assure the treatment of all Slickrock Creek area source AMD flows and contaminated BFP discharges during a 100-year, 3-day storm, the Protective Reservoir Size (PRS). Respondents shall also perform, and submit for EPA review and approval, a complete engineering analysis to determine the additional reservoir storage capacity that is necessary to assure protective emergency storage capacity during treatment plant upsets or downtime during adverse conditions (during a 100-year, 3-day storm), the Protective Emergency Capacity (PEC).

The 100-year, 3-day storm event criteria shall be selected using ANSI III conditions to provide a conservative analysis approach. The report shall include evaluation of how the reservoir would have responded to the past 3 years of storm events (1994-1995, 1995-1996, and 1996-1997).

- Hydrology Report - The Respondents shall prepare a Hydrology Report to be used for evaluation and selection of the spillway design flood, outlet works free board, surcharge storage, and dam crest elevation. The report shall include wave and wave runup analysis and riprap analysis.

- Hydraulics Report - The Respondents shall prepare a Hydraulics Report that provides for the hydraulic size and configuration of outlet works, emergency drain, and spillway.

- Geotechnical Data Report - The Respondents shall prepare a Geotechnical Data Report that contains, at a minimum, the data from the geological and geotechnical exploration and field and laboratory testing, including mineralogy, Atterburg limits, grain size analysis, moisture-density relationship, undisturbed and remolded (as appropriate) strength tests, consolidation, and permeability.

- Geology Report - The Respondents shall prepare a Geology Report and geologic map based on field mapping and literature review. The report shall contain geologic hazards assessment and seismic evaluation, including the design earthquake (EQ), and lateral acceleration.

- Geotechnical Design Report - The Respondents shall prepare a Geotechnical Design Report which shall contain an evaluation of the borings, geology and laboratory analysis and selection of design parameters. The report shall provide the basis of design of the dam including excavation, preparation and grouting of the foundation and abutments, embankment materials, stability analysis, seepage analysis and settlement analysis. After the analysis is completed, the configuration of the embankment shall be presented with a longitudinal section and typical cross sections.

- Structural Design Report - The Respondents shall prepare a Structural Design Report which shall contain the structural criteria and analysis for the outlet structure,

outlet conduit under the dam, and the spillway.

- Operation and Maintenance Plans and Descriptions Report - The Respondents shall prepare an Operation and Maintenance Plans and Descriptions Report for the dam structure, spillway and outlet works. (In conjunction with the Pre-final and Final Design Submittals only.)

- Additional Reports - The Respondents shall prepare additional reports as required or necessary to meet the substantive requirements of applicable permits and the requirements of the California DOSOD, or to provide EPA with sufficient information necessary to fully evaluate compliance of the proposed project with the substantive requirements of ARARs for on-site components or subcomponents of the project that do not require permits.

4.1.3 Preliminary Design and Engineering Analysis

Preliminary Design begins with the initial design and ends with the completion of approximately 30 percent of the design effort. The Respondents shall provide supporting data, engineering calculations and documentation with the design documents to define the functional aspects of the project to prove that the completed project will be effective in meeting the performance standards and objectives and all and applicable or relevant and appropriate requirements (ARARs). In accordance with the schedule established in the PDA, the Respondents shall submit, for EPA review and approval, the Preliminary Design Submittal, which shall consist of the following:

- The draft Preliminary Design EA Reports listed in Section 4.1.2, including all engineering calculations.

- The draft Design Criteria Report - The draft report shall define in detail the technical parameters upon which the design will be based. Specifically, the Design Criteria Report shall include the preliminary design assumptions and parameters, including geotechnical, hydrology, hydraulics, surveying, stabilizing concepts, and stability analysis.

- The recommended Preliminary Project Delivery Strategy and Scheduling - The schedule shall include an evaluation of a phased approach to expedite the remedial action.

- Preliminary Construction Schedule.

- Preliminary Environmental Control Measures Plan - The Plan shall provide plans for dust control, erosion control, slope stabilization, drainage control, and sedimentation

control.

- Preliminary Construction Quality Assurance and Quality Control (CQAQC) Plan - The CQAQC Plan shall provide a materials testing plan, inspector(s) qualifications and duties, inspection/testing frequencies, CQAQC reporting, laboratory certifications, and problem identification and corrective measures.
- Specifications Outline and drawing lists.
- Preliminary Design Drawings - Shall be submitted in both full-size and one-half-size reproductions.
- Preliminary Cost Estimate.
- Identification of long-lead procurement items.

As part of the Preliminary Design effort, Respondents shall attend:

- an informal one-day working design review meeting with EPA near the beginning of the performance of the Preliminary Design for the purpose of Respondents presenting descriptions of the initial design aspects and features that are expected to form the basis of the proposed Preliminary Design.
- a two-day meeting to present the Preliminary Design Submittal (approximate 30 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

The Respondents shall consolidate and respond to EPA's design review comments on the Preliminary Design Submittal (including comments on the draft Preliminary EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA. Within fourteen (14) days from the receipt of EPA's written comments on the draft Design Criteria Report, Respondents shall revise the draft Design Criteria Report to incorporate all EPA review comments and submit a Pre-final Design Criteria Report to EPA for review and approval. Within seven (7) days after approval by EPA, Respondents shall finalize the Design Criteria Report and submit the report to EPA.

4.1.4 Intermediate Design (50 Percent) Submittal

Intermediate Design begins with completion of the Preliminary Design and ends with the completion of approximately 50 percent of the design effort. The Intermediate Design Submittal shall be made after Respondents have provided responses to EPA

comments on the Preliminary Design Submittal (including comments on the draft Preliminary Design EA Reports). EPA's comments on the Preliminary Design Submittal shall be incorporated into the Intermediate Design. The Respondents shall provide supporting data, engineering calculations and documentation with the design documents to define the functional aspects of the project that demonstrate that the completed project will be effective in meeting the performance standards and objectives and all ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit, for EPA review and approval, the Intermediate Design Submittal, which shall consist of the following:

- Each of the draft Intermediate Design EA Reports listed in Section 4.1.2, updated from the draft Preliminary Design EA Reports with information and analyses currently available, including all engineering calculations;
- Revised Project Delivery Strategy and Schedule;
- Revised Construction Schedule;
- Revised Design Environmental Control Measures Plan;
- Revised Construction Quality Assurance and Quality Control Plan;
- Intermediate Design Specifications;
- Intermediate Design Drawings - The drawings and schematics shall be to true scale to fully describe the project and shall present sufficient information to clearly describe the project and reflect organization and clarity. Engineering drawings shall be submitted in full-size and one-half-size reproductions;
- Revised Cost Estimate;
- Revised Identification of long-lead procurement items; and
- Requirements of California DOSOD.

As part of the Intermediate Design effort Respondents shall attend:

- One one-day informal design review meeting with EPA during the performance of the Intermediate Design for the purpose of presenting descriptions of the design aspects and features being incorporated. The meeting shall be held about halfway through Intermediate Design. The schedule for this meeting shall be described in the PDA; and
- One two-day meeting to present the Intermediate Design Submittal (approximate 50 Percent Design) to EPA, including participation of key design staff, approximately

one (1) week after submittal.

The Respondents shall consolidate and respond to EPA's design review comments on the Intermediate Design and draft Intermediate Design EA Reports. Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

4.1.5 Pre-final Design (90 Percent) and Final Design (100 Percent) Submittals

The Respondents shall submit the Pre-final Design for the Slickrock Creek Retention Reservoir dam structure, spillway and outlet works for EPA review and approval. The Pre-final Design shall function as the draft version of the Final Design. The Pre-final Design shall address comments generated from the Intermediate Design and clearly show any modifications of the design as a result of incorporation of the comments. After EPA review and comment on the Pre-final Design, Respondents shall incorporate all EPA comments and submit the Final Design. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California. EPA approval of the Final Design is required before initiating the RA, unless specifically authorized by EPA.

The Pre-final Design Submittal shall include the following:

- Pre-final Construction Schedule - The schedule for implementation of the RA shall identify the timing for initiation and completion of all critical path tasks. The schedule shall specifically identify duration for completion of the project and major milestones.
- Pre-final Design Specifications and Pre-final Drawings - A complete set of construction drawings and specifications (general specifications, drawings, and schematics) shall be submitted at the Pre-final stage. All specifications shall conform to Construction Specification Institute (CSI) format.
- Pre-final Design EA Reports listed in Section 4.1.2. The reports shall incorporate any changes since the 50 percent draft Intermediate Design EA Reports, including all engineering calculations.
- Pre-final RA Cost Estimate.
- Pre-final Project Delivery Strategy.

As part of the Pre-final Design effort Respondents shall attend:

- one two-day meeting to present the Pre-final Design Submittal (approximate 90 percent design) to EPA, including participation by Respondents' key design staff, approximately one (1) week after submittal.

The Respondents shall consolidate and respond to EPA's design review comments on the Pre-final Design and draft Pre-final Design EA Reports. Within fourteen (14) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. The Final Design Submittal shall incorporate all EPA comments on the Pre-final Design Submittal, implement all design changes required by EPA, and include the following:

- Final Construction Schedule
- Final Design Specifications and Final Drawings - The final submittals shall include a complete set of full-size construction drawings and specifications as well as a set of one-half-size reductions of drawings. All Final Design Specifications and Drawings shall be approved, sealed, and signed by a Professional Engineer registered in California.
- Final EA Reports listed in Section 4.1.2. The reports shall incorporate any changes since the 90 percent draft Pre-final Design EA Report. All Final Design EA Reports shall be approved, sealed, and signed by a Professional Engineer registered in California.
- Final RA Cost Estimate.
- Final Project Delivery Strategy.

4.2 Hematite Retention Structure

4.2.1 Performance Standards and Objectives

The Hematite pile shows signs of severe erosion. The objective of this Work is to stabilize the Hematite pile to prevent erosion or drainage that could damage the dam or appurtenances, or contaminate the water in Slickrock Creek and downstream areas.

The Respondents shall design the Hematite retention structure in accordance with California mining waste requirements and good engineering practice to achieve the following performance standards and objectives:

- The Hematite retention structure(s) shall be constructed to prevent erosion of the Hematite piles (gossan tailings) into Slickrock Creek or the Slickrock Creek retention

reservoir. These facilities shall consist of embankment(s) or other approved design.

- The hematite retention structure(s) shall be designed in a robust and reliable manner and shall be founded on bedrock.
- Analyses shall be conducted and presented for EPA approval demonstrating that all components of the Hematite retention structures are robust and will prevent erosion of the tailings in a 100-year design storm event (ANSI III conditions).
- The Hematite retention structures shall allow water to pass through the structures while preventing the gossan tailings from eroding into Slickrock Creek or the reservoir.

4.2.2 Preliminary Design and Engineering Analysis

Preliminary Design begins with the initial design and ends with the completion of approximately 30 percent of the design effort. The Respondents shall provide supporting data, engineering calculations and other documentation with the design documents to define the functional aspects of the project to prove that the completed project will be effective in meeting the performance standards and objectives and all ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit to EPA the Preliminary Design Submittal, which shall consist of the following:

- The draft Preliminary Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Hydraulic and Stability) - Shall provide data, borings, laboratory tests, geological mapping, hydrologic analysis, hydraulic analysis, stability analysis and interpretation.
- The Preliminary Design engineering calculations.
- The draft Design Criteria Report - The draft report shall define in detail the technical parameters upon which the design will be based. Specifically, the Design Criteria Report shall include the preliminary design assumptions and parameters, including geotechnical, hydrology, hydraulics, surveying, stabilizing concepts, and stability analysis.
- The recommended Preliminary Project Delivery Strategy and Scheduling - The schedule shall include an evaluation of a phased approach to expedite the remedial action.
- Preliminary Construction Schedule.
- Preliminary Environmental Control Measures Plan - The Plan shall provide plans for dust control, erosion control, slope stabilization, drainage control, and sedimentation

control.

- Preliminary Construction Quality Assurance and Quality Control Plan - Tha Plan shall provide plans for materials testing, inspector(s) qualifications and duties, inspection/testing frequencies, reporting, laboratory certifications, and problem identification and corrective measures.
- Specifications Outline and drawing lists.
- Preliminary Drawings - Shall be submitted in both full-size and one-half-size reproductions.
- Preliminary Cost Estimate.
- Preliminary Identification of long-lead procurement items.

As part of the Preliminary Design effort, Respondents shall attend:

- an informal one-day working design review meeting with EPA near the beginning of the performance of the Preliminary Design for the purpose of Respondents presenting descriptions of the initial design aspects and features that are expected to form the basis of the proposed Preliminary Design.
- a two-day meeting to present the Preliminary Design Submittal (approximate 30 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Preliminary Design Submittal (including the draft Preliminary Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA. Within fourteen (14) days from the receipt of EPA's written comments on the draft Design Criteria Report, Respondents shall revise the draft Design Criteria Report to incorporate all EPA review comments and submit a Pre-final Design Criteria Report to EPA for review and approval. Within seven (7) days after approval by EPA, Respondents shall finalize the Design Criteria Report and submit the report to EPA.

4.2.3 Intermediate Design (50 Percent) Submittal

Intermediate Design begins with completion of the Preliminary Design and ends with the completion of approximately 50 percent of the design effort. The Intermediate Design Submittal shall be made after Respondents have provided responses to EPA comments on the Preliminary Design Submittal. EPA's comments on the Preliminary Design Submittal shall be incorporated into the Intermediate Design. The Respondents shall provide supporting data, engineering calculations and documentation with the design documents to define the functional aspects of the project that demonstrate that the completed project will be effective in meeting the performance standards and objectives and all ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit, for EPA review and approval, the Intermediate Design Submittal, which shall consist of the following:

- The draft Intermediate Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Hydraulic and Stability). The draft reports shall incorporate any changes since the Preliminary Design (approximate 30 percent).

- Intermediate Design engineering calculations. The calculations shall incorporate any changes since the Preliminary Design (approximate 30 percent).

- Revised Project Delivery Strategy and Schedule;

- Revised Construction Schedule;

- Revised Design Environmental Control Measures Plan;

- Revised Construction Quality Assurance and Quality Control Plan;

- Intermediate Design Specifications;

- Intermediate Design Drawings - The drawings shall be to true scale to fully describe the project and shall present sufficient information to clearly describe the project and reflect organization and clarity. Engineering drawings shall be submitted in full-size and one-half-size reproductions;

- Revised Cost Estimate;

- Revised Identification of long-lead procurement items; and

- Requirements of California DOSOD.

As part of the Intermediate Design effort Respondents shall attend:

- One one-day informal design review meeting with EPA during the performance of

the Intermediate Design for the purpose of presenting descriptions of the design aspects and features being incorporated. The meeting shall be held about halfway through Intermediate Design. The schedule for this meeting shall be described in the PDA; and

- One two-day meeting to present the Intermediate Design Submittal (approximate 50 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Intermediate Design Submittal (including the draft Intermediate Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

4.2.4 Pre-final Design (90 Percent) and Final Design (100 Percent) Submittals

The Respondents shall submit the Pre-final Design for the Hematite Retention Structure for EPA review and approval. The Pre-final Design shall function as the draft version of the Final Design. The Pre-final Design shall address comments generated from the Intermediate Design and clearly show any modifications of the design as a result of incorporation of the comments. After EPA review and comment on the Pre-final Design, Respondents shall incorporate all EPA comments and submit the Final Design. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California. EPA approval of the Final Design is required before initiating the RA, unless specifically authorized by EPA.

The Pre-final Design Submittal shall include the following:

- Pre-final Construction Schedule - The schedule for implementation of the RA shall identify the timing for initiation and completion of all critical path tasks. The schedule shall specifically identify duration for completion of the project and major milestones.
- Pre-final Design Specifications and Pre-final Drawings - A complete set of construction drawings and specifications (general specifications, drawings, and schematics) shall be submitted at the Pre-final stage. All specifications shall conform to Construction Specification Institute (CSI) format.

- The draft Pre-final Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Hydraulic and Stability). The reports shall incorporate any changes since the 50 percent draft Intermediate Design.

- The Pre-final Design engineering calculations. The pre-final design calcluations shall incorporate any changes since the 50 percent draft Intermediate Design.

- Pre-final RA Cost Estimate.

- Pre-final Project Delivery Strategy.

As part of the Pre-final Design effort Respondents shall attend:

- one two-day meeting to present the Pre-final Design Submittal (approximate 90 percent design) to EPA, including participation by Respondents' key design staff, approximately one (1) week after submittal.

This design review meeting may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Pre-final Design Submittal (including the draft Pre-final Design EA Reports). Within fourteen (14) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

The Final Design Submittal shall incorporate all EPA comments on the Pre-final Design Submittal, implement all design changes required by EPA, and include the following:

- Final Construction Schedule

- Final Design Specifications and Final Drawings - The final submittals shall include a complete set of full-size construction drawings and specifications as well as a set of one-half-size reductions of drawings. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California.

- The Final Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Hydraulic and Stability). The reports shall incorporate any changes since the 90 percent draft Pre-final Design. The Final Design EA Reports shall be approved, sealed, and signed by a Professional Engineer registered in California.

- The Final Design engineering calculations. The calculations shall incorporate any changes since the Pre-final Design (approximate 90 percent).

- Final RA Cost Estimate.

- Final Project Delivery Strategy.

4.3 Sediment and Debris Basin(s) or Other Approved Control Structure(s)

4.3.1 Performance Standards and Objectives

The location of the Slickrock Creek Retention Reservoir is in a narrow steep canyon with large quantities of waste rock from numerous mining activities sidecast onto the steep slopes on the north side of the Slickrock Creek watershed above the proposed retention reservoir site. The objective of the sediment and debris basin(s) (or other EPA approved control structure(s)) is to collect the mine waste material and prevent it from entering the retention reservoir.

The Respondents shall design the sediment and debris basin(s) (or other EPA approved control structure(s)) in accordance with good engineering practice to achieve the following performance standards and objectives:

- A sedimentation basin(s) (or other EPA approved control structure(s)) shall be constructed upstream of the Slickrock Creek Retention Reservoir. The sediment and debris basin(s) shall have a minimum design capacity of 5 acre-feet of sedimentation per year. Engineering analyses shall be performed to evaluate the upgradient sediment flows and waste piles below Brick Flat Pit, runoff flow rates, hydraulics, sediment transport, settling rates, and retention times to determine if the sediment and debris basin(s) shall be sized to accomodate sedimentation rates larger than 5 acre-feet per year. The sediment and debris basin(s) shall be sized to accommodate sediment loadings associated with 100-year storm events runoff.

- The sediment and debris basin(s) (or other EPA approved control structure(s)) shall minimize the sediment and debris load to the retention reservoir to allow reliable continuous operation of the lowest level gate in the outlet works.

- All-weather and year-round access by O&M retention vehicles for cleanout and maintenance of the sediment and debris basin(s) shall be provided.

- The sediment and debris basin(s), any debris traps or other EPA approved sediment and debris controls, and AMD retention reservoir shall prevent particles larger than 0.1 mm from passing through the outlet works. As a minimum, the sediment and debris basin(s) shall prevent particles greater than 1.0 mm from passing into the Slickrock Creek Retention Reservoir.

- To the maximum extent possible,all upstream activities shall be conducted in a manner that decreases the movement of hillside materials, minimizes the potential for mud flows and slope failures, and that provides stability to the adjacent landslide area. Robust erosion control features shall be incorporated into all elements of the design of the sediment and debris basin(s) and all excavations and fills connected with the construction of all facilities within the Slickrock Creek Basin.

- Operation and maintenance plans shall be developed to provide for disposal of the sediment and debris collected in the sediment and debris basin(s) and the reservoir in a manner which prevents future erosion into Slickrock Creek and downstream drainage.

4.3.2 Preliminary Design and Engineering Analysis

Preliminary Design begins with the initial design and ends with the completion of approximately 30 percent of the design effort. The Respondents shall provide supporting data, engineering calculations and other documentation with the design documents to define the functional aspects of the project to prove that the completed project will be effective in meeting the performance standards and objectives and all ARARs. In accordance with the schedule established in the PDA, the Respondents

shall submit to EPA the Preliminary Design, which shall, as a minimum, consist of the following, and which shall provide additional information as necessary to define the Preliminary Design:

- The draft Preliminary Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Stability and Hydraulic) - The reports shall provide flood flows, sediment volume, geological map, and stability analysis.

- The draft Preliminary Design Operations and Maintenance Plan- The draft Plan shall present the overall concept for managing control and disposal of sediment above the Slickrock Creek Retention Reservoir.

- The draft Design Criteria Report - The report shall define in detail the technical parameters upon which the design will be based. Specifically, the Design Criteria Report shall include the preliminary design assumptions and parameters, including geotechnical, hydrology, hydraulic, surveys, basin locations, stability analysis, and preliminary layouts and cross sections.

- The Preliminary Design engineering calculations.

- The recommended Preliminary Project Delivery Strategy and Scheduling - The schedule shall include an evaluation of a phased approach to expedite the RA.

- Preliminary Construction Schedule.
- Preliminary Environmental Control Measures Plan - The Plan shall provide plans for dust control, erosion control, slope stabilization, drainage control, and sedimentation control.
- Preliminary Construction Quality Assurance and Quality Control Plan - The Plan shall provide plans for materials testing, inspector(s) qualifications and duties, inspection/testing frequencies, reporting, laboratory certifications, and problem identification and corrective measures.
- Specifications Outline and Drawing List.
- Preliminary Drawings - Engineering drawings shall be to true scale necessary to fully describe the sediment and debris basin(s) and shall be submitted in full-size and one-half-size reproductions.
- Preliminary Cost Estimate.

As part of the Preliminary Design effort, Respondents shall attend:

- an informal one-day working design review meeting with EPA near the beginning of the performance of the Preliminary Design for the purpose of Respondents presenting descriptions of the initial design aspects and features that are expected to form the basis of the proposed Preliminary Design.
- a two-day meeting to present the Preliminary Design Submittal (approximate 30 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Preliminary Design Submittal (including the draft Preliminary Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA. Within fourteen (14) days from the receipt of EPA's written comments on the draft Design Criteria Report, Respondents shall revise the draft Design Criteria Report to incorporate all EPA review comments and submit a Pre-final Design Criteria Report to EPA for review and approval. Within seven (7) days after approval by EPA, Respondents shall finalize the

Design Criteria Report and submit the report to EPA.

4.3.3 Intermediate Design (50 Percent) Submittal

Intermediate Design begins with completion of the Preliminary Design and ends with the completion of approximately 50 percent of the design effort. The Intermediate Design Submittal shall be made after Respondents have provided responses to EPA comments on the Preliminary Design Submittal. EPA's comments on the Preliminary Design Submittal shall be incorporated into the Intermediate Design. The Respondents shall provide supporting data, engineering calculations and documentation with the design documents to define the functional aspects of the project that demonstrate that the completed project will be effective in meeting the performance standards and objectives and all ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit, for EPA review and approval, the Intermediate Design Submittal, which shall consist of the following:

- The draft Intermediate Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Stability and Hydraulic). The draft reports shall incorporate any changes since the 30 percent draft Preliminary Design.
- The draft Intermediate Design Operations and Maintenance Plan- The draft Intermediate Design Plan shall present the intermediate design (approximate 50 percent complete) for managing control and disposal of sediment above the Slickrock Creek Retention Reservoir.
- Intermediate Design engineering calculations. The calculations shall incorporate any changes since the Preliminary Design (approximate 30 percent).
- Revised Project Delivery Strategy and Schedule.
- Revised Construction Schedule.
- Revised Design Environmental Control Measures Plan.
- Revised Construction Quality Assurance and Quality Control Plan.
- Intermediate Design Specifications.
- Intermediate Design Drawings - The drawings shall be to true scale to fully describe the project and shall present sufficient information to clearly describe the project and reflect organization and clarity. Engineering drawings shall be submitted in full-size and one-half-size reproductions;
- Revised Cost Estimate;
- Requirements of California DOSOD.

As part of the Intermediate Design effort Respondents shall attend:

- One one-day informal design review meeting with EPA during the performance of the Intermediate Design for the purpose of presenting descriptions of the design aspects and features being incorporated. The meeting shall be held about halfway through Intermediate Design. The schedule for this meeting shall be described in the PDA; and

- One two-day meeting to present the Intermediate Design Submittal (approximate 50 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Intermediate Design Submittal (including the draft Intermediate Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

4.3.4 Pre-final Design (90 Percent) and Final Design (100 Percent) Submittals

The Respondents shall submit the Pre-final Design for the sediment and debris basin(s) (or other EPA approved control structure(s)) for EPA review and approval. The Pre-final Design shall function as the draft version of the Final Design. The Pre-final Design shall address comments generated from the Intermediate Design and clearly show any modifications of the design as a result of incorporation of the comments. After EPA review and comment on the Pre-final Design, Respondents shall incorporate all EPA comments and submit the Final Design. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California. Unless expressly authorized by EPA, Respondents shall not initiate RA activities pursuant to this Order until EPA approves the Final Design.

The Pre-final Design Submittal shall include the following:

- Pre-final Construction Schedule - The schedule for implementation of the RA shall identify the timing for initiation and completion of all critical path tasks. The schedule shall specifically identify duration for completion of the project and major milestones.

- Pre-final Design Specifications and Pre-final Drawings - A complete set of construction drawings and specifications (general specifications, drawings, and schematics) shall be submitted at the Pre-final stage. All specifications shall

conform to Construction Specification Institute (CSI) format.

- The draft Pre-final Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Stability and Hydraulic). The reports shall incorporate any changes since the Intermediate Design (approximate 50 percent).
- The Pre-final Design Operations and Maintenance Plan- The Plan shall present the pre-final design (approximate 90 percent complete) plan for managing control and disposal of sediment above the Slickrock Creek Retention Reservoir.
- The Pre-final Design engineering calculations. The calculations shall incorporate any changes since the Intermediate Design (approximate 50 percent).
- Pre-final RA Cost Estimate.
- Pre-final Project Delivery Strategy.

As part of the Pre-final Design effort Respondents shall attend:

- one two-day meeting to present the Pre-final Design Submittal (approximate 90 percent design) to EPA, including participation by Respondents' key design staff, approximately one (1) week after submittal.

This design review meeting may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Pre-final Design Submittal (including the draft Pre-final Design EA Reports). Within fourteen (14) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

The Final Design Submittal shall incorporate all EPA comments on the Pre-final Design Submittal, implement all design changes required by EPA, and include the following:

- Final Construction Schedule
- Final Design Specifications and Final Drawings - The final submittals shall include a complete set of full-size construction drawings and specifications as well as a set of one-half-size reductions of drawings. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California.
- The Final Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Stability and Hydraulic). The reports shall incorporate any changes since the 50 percent draft Intermediate Design. The Final Design EA Reports shall be approved, sealed,

and signed by a Professional Engineer registered in California.

- The Final Design Operations and Maintenance Plan- The Plan shall present the pre-final design (approximate 90 percent complete) plan for managing control and disposal of sediment above the Slickrock Creek Retention Reservoir.
- The Final Design engineering calculations. The calculations shall incorporate any changes since the Pre-final Design (approximate 90 percent).
- Final RA Cost Estimate.
- Final Project Delivery Strategy.

4.4 Slickrock Creek Clean Water Diversion System

4.4.1 Performance Standards and Objectives

The Slickrock Creek Clean Water Diversion System shall be designed in accordance with good engineering practice to achieve the following performance standards and objectives:

- Clean Water Diversions shall be designed and constructed to maximize the collection and diversion of uncontaminated surface water away from the Slickrock Creek Retention Reservoir and the Hematite piles.
- The Clean Water Diversion(s) shall incorporate a robust design approach that ensures reliable, long-term, and highly secure capture and diversion of all 100-year storm events. The 100-year storm event shall be selected using the most conservative analyses (i.e., providing the largest volume and/or the largest flow rate) approach as approved by EPA.
- The Clean Water Diversion(s) shall be designed for long-term stability, shall be constructed on foundations that consist of highly compacted or cut slopes, and shall be accessible for maintenance and cleanout year-round.
- Clean water from Brick Flat Pit shall be separated from contaminated Brick Flat Pit discharges and conveyed downstream of the Slickrock Creek Reservoir.
- Hill slopes supporting the Clean Water Diversion(s) shall be analyzed for static and seismic stability and shall be reconstructed or reinforced to provide sufficient factors of safety to ensure stability under all design conditions.
- The design shall include year-round vehicle access to the Upper Slickrock Creek Catfish Pond area under all weather conditions.

4.4.2 Preliminary Design and Engineering Analysis

Preliminary Design begins with the initial design and ends with the completion of approximately 30 percent of the design effort. The Respondents shall provide supporting data and documentation with the design documents to define the functional aspects of the project to prove that the completed project will be effective in meeting the objectives and ARARs. In accordance with the schedule established in the PDA, Respondents shall submit to EPA the Preliminary Design, which shall, as a minimum, consist of the following, and which shall provide additional information as necessary to define the Preliminary Design:

- The draft Preliminary Design EA Reports (Survey, Geology, and Hydrology, Geotechnical, Stability and Hydraulic) - Shall provide flows and geologic maps and stability analysis for diversion concepts;
- The Preliminary Design engineering calculations.
- A draft engineering evaluation of the performance of the existing Slickrock Creek clean water diversion system;
- The draft Design Criteria Report - The report shall define in detail the technical parameters upon which the design will be based. Specifically, the Design Criteria Report shall include the preliminary design assumptions and parameters, including geotechnical, hydrology, hydraulic analysis, survey, diversion location, diversion concepts, preliminary layouts, and sections;
- The recommended Preliminary Project Delivery Strategy and Scheduling - The schedule shall include an evaluation of a phased approach to expedite the RA;
- Preliminary Construction Schedule;
- Preliminary Environmental Control Measures Plan - The Plan shall provide plans for dust control; erosion control, slope stabilization, drainage control, and sedimentation control;
- Preliminary Construction Quality Assurance and Quality Control Plan - The Plan shall provide plans for materials testing, inspector(s) qualifications and duties, inspection/testing frequencies, reporting, laboratory certifications, and problem identification and corrective measures;
- Specifications Outline and Drawing List;
- Preliminary Drawings - Engineering drawings shall be to true scale to fully describe the facilities being constructed and shall be submitted in full-size and one-half-size

reproductions;

- Preliminary Cost Estimate;

As part of the Preliminary Design effort, Respondents shall attend:

- an informal one-day working design review meeting with EPA near the beginning of the performance of the Preliminary Design for the purpose of Respondents presenting descriptions of the initial design aspects and features that are expected to form the basis of the proposed Preliminary Design.

- a two-day meeting to present the Preliminary Design Submittal (approximate 30 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Preliminary Design Submittal (including the draft Preliminary Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA. Within fourteen (14) days from the receipt of EPA's written comments on the draft Design Criteria Report, Respondents shall revise the draft Design Criteria Report to incorporate all EPA review comments and submit a Pre-final Design Criteria Report to EPA for review and approval. Within seven (7) days after approval by EPA, Respondents shall finalize the Design Criteria Report and submit the report to EPA. Within fourteen (14) days from the receipt of EPA's written comments on the draft engineering evaluation of the performance of the existing Slickrock Creek clean water diversion system, Respondents shall revise the draft engineering evaluation to incorporate all EPA review comments and submit a pre-final engineering evaluation report to EPA for review and approval. Within seven (7) days after approval by EPA, Respondents shall finalize the engineering evaluation report and submit the report to EPA.

4.4.3 Intermediate Design (50 Percent) Submittal

Intermediate Design begins with completion of the Preliminary Design and ends with the completion of approximately 50 percent of the design effort. The Intermediate Design Submittal shall be made after Respondents have provided responses to EPA comments on the Preliminary Design Submittal. EPA's comments on the Preliminary Design Submittal shall be incorporated into the Intermediate Design. The Respondents shall provide supporting data, engineering calculations and documentation with the design documents to define the functional aspects of the project that demonstrate that

the completed project will be effective in meeting the performance standards and objectives and all ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit, for EPA review and approval, the Intermediate Design Submittal, which shall consist of the following:

- The draft Intermediate Design EA Reports (Survey, Geology, and Hydrology, Geotechnical, Stability and Hydraulic). The draft reports shall incorporate any changes since the draft Preliminary Design EA Reports (approximate 30 percent).
- Intermediate Design engineering calculations. The reports shall incorporate any changes since the Preliminary Design (approximate 30 percent).
- Revised Project Delivery Strategy and Schedule;
- Revised Construction Schedule;
- Revised Design Environmental Control Measures Plan;
- Revised Construction Quality Assurance and Quality Control Plan;
- Intermediate Design Specifications;
- Intermediate Design Drawings - The drawings shall be to true scale to fully describe the project and shall present sufficient information to clearly describe the project and reflect organization and clarity. Engineering drawings shall be submitted in full-size and one-half-size reproductions;
- Revised Cost Estimate;

As part of the Intermediate Design effort Respondents shall attend:

- One one-day informal design review meeting with EPA during the performance of the Intermediate Design for the purpose of presenting descriptions of the design aspects and features being incorporated. The meeting shall be held about halfway through Intermediate Design. The schedule for this meeting shall be described in the PDA; and
- One two-day meeting to present the Intermediate Design Submittal (approximate 50 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Intermediate Design Submittal (including the draft Intermediate Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written

response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

4.4.4 Pre-final Design (90 Percent) and Final Design (100 Percent) Submittals

The Respondents shall submit the Pre-final Design for the Slickrock Creek Clean Water Diversion System for EPA review and approval. The Pre-final Design shall function as the draft version of the Final Design. The Pre-final Design shall address comments generated from the Intermediate Design and clearly show any modifications of the design as a result of incorporation of the comments. After EPA review and comment on the Pre-final Design, Respondents shall incorporate all EPA comments and submit the Final Design. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California. Unless expressly authorized by EPA, Respondents shall not initiate RA activities pursuant to this Order unless and until EPA approves the Final Design.

The Pre-final Design Submittal shall include the following:

- Pre-final Construction Schedule - The schedule for implementation of the RA shall identify the timing for initiation and completion of all critical path tasks. The schedule shall specifically identify duration for completion of the project and major milestones.
- Pre-final Design Specifications and Pre-final Drawings - A complete set of construction drawings and specifications (general specifications, drawings, and schematics) shall be submitted at the Pre-final stage. All specifications shall conform to Construction Specification Institute (CSI) format.
- The draft Pre-final Design EA Reports (Survey, Geology, and Hydrology, Geotechnical, Stability and Hydraulic). The reports shall incorporate any changes since the Intermediate Design EA Reports (approximate 50 percent).
- The Pre-final Design engineering calculations. The calculations shall incorporate any changes since the Intermediate Design (approximate 50 percent).
- Pre-final RA Cost Estimate.
- Pre-final Project Delivery Strategy.

As part of the Pre-final Design effort Respondents shall attend:

- one two-day meeting to present the Pre-final Design Submittal (approximate

90 percent design) to EPA, including participation by Respondents' key design staff, approximately one (1) week after submittal.

This design review meeting may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Pre-final Design Submittal (including the draft Pre-final Design EA Reports). Within fourteen (14) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

The Final Design Submittal shall incorporate all EPA comments on the Pre-final Design Submittal, implement all design changes required by EPA, and include the following:

- Final Construction Schedule
- Final Design Specifications and Final Drawings - The final submittals shall include a complete set of full-size construction drawings and specifications as well as a set of one-half-size reductions of drawings. All Final Design Specifications and Final Drawings shall be approved, sealed, and signed by a Professional Engineer registered in California.
- The Final Design EA Reports (Survey, Geology, and Hydrology, Geotechnical, Stability and Hydraulic) . The reports shall incorporate any changes since the Pre-final Design (approximate 90 percent). The Final Design EA Reports shall be approved, sealed, and signed by a Professional Engineer registered in California.
- The Final Design engineering calculations. The calculations shall incorporate any changes since the Pre-final Design (approximate 90 percent).
- Final RA Cost Estimate.
- Final Project Delivery Strategy.

4.5 Other Work associated with Slickrock Creek Retention Reservoir

The Respondents shall design, construct, and maintain the following Work in accordance with good engineering practice:

- Necessary new access roads and necessary relocation of existing access roads related to implementation of ROD4;
- Necessary Revegetation related to implementation of ROD4;

- Remote instrumentation requirements;
- Incorporation of Old/No. 8 Mine Seep conveyance pipeline; and
- Any other work necessary for the design, construction, and operation of the Slickrock Creek Retention Reservoir.

The existing Old/No. 8 Mine Seep pumping and conveyance system shall be maintained as operational during and after construction of the dam. A gravity collection and conveyance system into the reservoir shall be provided to allow for non-pumped AMD collection of the Old/No. 8 Mine Seep within the reservoir.

4.5.1 Preliminary Design

Preliminary Design begins with the initial design and ends with the completion of approximately 30 percent of the design effort. The Respondents shall provide supporting data, engineering calculations, and other documentation with the design documents to define the functional aspects of the project to prove that the completed project will be effective in meeting the remediation goals and ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit to EPA the Preliminary Design Submittal which shall, as a minimum, consist of the following, and which shall provide additional information as necessary to define the Preliminary Design:

- The draft Design Criteria Report - The report shall define in detail the technical parameters upon which the design will be based. Specifically, the Design Criteria Report shall include the preliminary design assumptions and parameters, including evaluation of the existing access road in conjunction with the Work in Section 5.1, geotechnical conditions, geology, topographic survey, stability evaluation for access road, details of the existing Old/No. 8 Mine Seep pump and conveyance pipeline, areas to be revegetated, and remote instrumentation required.
- The draft Preliminary Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Hydraulic and Stability Reports).
- The Preliminary Design engineering calculations.
- The recommended Preliminary Project Delivery Strategy and Scheduling - The schedule shall include an evaluation of a phased approach to expedite the RA.
- Preliminary Construction Schedule.
- Preliminary Environmental Control Measures Plan - The Plan shall provide plans for dust control, erosion control, slope stabilization, drainage control, and sedimentation control.

- Preliminary Construction Quality Assurance and Quality Control Plan - The Plan shall provide plans for materials testing, inspector(s) qualifications and duties, inspection/testing frequencies, reporting, laboratory certifications, and problem identification and corrective measures.

- Preliminary Cost Estimate.

- Specifications Outline and Drawings List.

- Preliminary Drawings - Engineering drawings shall be to true scale to fully describe the Other Work items and shall be submitted in full-size and one-half-size reproductions.

- Preliminary Identification of long-lead procurement items.

As part of the Preliminary Design effort, Respondents shall attend:

- an informal one-day working design review meeting with EPA near the beginning of the performance of the Preliminary Design for the purpose of Respondents presenting descriptions of the initial design aspects and features that are expected to form the basis of the proposed Preliminary Design.

- a two-day meeting to present the Preliminary Design Submittal (approximate 30 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Preliminary Design Submittal (including the draft Preliminary Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA. Within fourteen (14) days from the receipt of EPA's written comments on the draft Design Criteria Report, Respondents shall revise the draft Design Criteria Report to incorporate all EPA review comments and submit a Pre-final Design Criteria Report to EPA for review and approval. Within seven (7) days after approval by EPA, Respondents shall finalize the Design Criteria Report and submit the report to EPA.

4.5.2 Intermediate Design (50 Percent) Submittal

Intermediate Design begins with completion of the Preliminary Design and ends with the completion of approximately 50 percent of the design effort. The Intermediate

Design Submittal shall be made after Respondents have provided responses to EPA comments on the Preliminary Design Submittal. EPA's comments on the Preliminary Design Submittal shall be incorporated into the Intermediate Design. The Respondents shall provide supporting data, engineering calculations and documentation with the design documents to define the functional aspects of the project that demonstrate that the completed project will be effective in meeting the performance standards and objectives and all ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit, for EPA review and approval, the Intermediate Design Submittal, which shall consist of the following:

- The draft Intermediate Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Hydraulic and Stability Reports). The reports shall incorporate any changes since the Preliminary Design (approximate 30 percent).
- Intermediate Design engineering calculations. The calculations shall incorporate any changes since the Preliminary Design (approximate 30 percent).
- Revised Project Delivery Strategy and Schedule;
- Revised Construction Schedule;
- Revised Design Environmental Control Measures Plan;
- Revised Construction Quality Assurance and Quality Control Plan;
- Intermediate Design Specifications;
- Intermediate Design Drawings - The drawings shall be to true scale to fully describe the project and shall present sufficient information to clearly describe the project and reflect organization and clarity. Engineering drawings shall be submitted in full-size and one-half-size reproductions;
- Revised Cost Estimate;
- Revised Identification of long-lead procurement items; and

As part of the Intermediate Design effort Respondents shall attend:

- One one-day informal design review meeting with EPA during the performance of the Intermediate Design for the purpose of presenting descriptions of the design aspects and features being incorporated. The meeting shall be held about halfway through Intermediate Design. The schedule for this meeting shall be described in the PDA; and
- One two-day meeting to present the Intermediate Design Submittal (approximate 50 Percent Design) to EPA, including participation of key design staff, approximately

one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Intermediate Design Submittal (including the draft Intermediate Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

4.5.3 Pre-final Design (90 Percent) and Final Design (100 Percent) Submittals

The Respondents shall submit the Pre-final Design for the Other Work associated with the implementation of the Slickrock Creek Retention Reservoir for EPA review and approval. The Pre-final Design shall function as the draft version of the Final Design. The Pre-final Design shall address comments generated from the Intermediate Design and clearly show any modifications of the design as a result of incorporation of the comments. After EPA review and comment on the Pre-final Design, Respondents shall incorporate all EPA comments and submit the Final Design. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California. Unless expressly authorized by EPA, Respondents shall not initiate RA activities purusant to this Order until EPA approves the Final Design.

The Pre-final Design Submittal shall include the following:

- Pre-final Construction Schedule - The schedule for implementation of the RA shall identify the timing for initiation and completion of all critical path tasks. The schedule shall specifically identify duration for completion of the project and major milestones.

- Pre-final Design Specifications and Pre-final Drawings - A complete set of construction drawings and specifications (general specifications, drawings, and schematics) shall be submitted at the Pre-final stage. All specifications shall conform to Construction Specification Institute (CSI) format.

- The draft Pre-final Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Hydraulic and Stability Reports). The reports shall incorporate any changes since the 50 percent draft Intermediate Design.

- The Pre-final Design engineering calculations. The calculations shall incorporate any changes since the 50 percent draft Intermediate Design.

- Pre-final RA Cost Estimate.

- Pre-final Project Delivery Strategy.

As part of the Pre-final Design effort Respondents shall attend:

- one two-day meeting to present the Pre-final Design Submittal (approximate 90 percent design) to EPA, including participation by Respondents' key design staff, approximately one (1) week after submittal.

This design review meeting may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Pre-final Design Submittal (including the draft Pre-final Design EA Reports). Within fourteen (14) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

The Final Design Submittal shall incorporate all EPA comments on the Pre-final Design Submittal, implement all design changes required by EPA, and include the following:

- Final Construction Schedule
- Final Design Specifications and Final Drawings - The final submittals shall include a complete set of full-size construction drawings and specifications as well as a set of one-half-size reductions of drawings. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California.
- The Final Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Hydraulic and Stability Reports). The reports shall incorporate any changes since the 90 percent draft Intermediate Design. The Final Design EA Reports shall be approved, sealed, and signed by a Professional Engineer registered in California.
- The Final Design engineering calculations. The calculations shall incorporate any changes since the 50 percent draft Intermediate Design.
- Final RA Cost Estimate.
- Final Project Delivery Strategy.

5.0 DESIGN ACTIVITIES - ACID MINE DRAINAGE CONVEYANCE SYSTEM

5.1 Acid Mine Drainage Conveyance System - Slickrock Creek Reservoir to Boulder Creek Crossing

5.1.1 Performance Standards and Objectives

The Respondents shall evaluate the existing AMD Conveyance System between Slickrock Creek Reservoir and Boulder Creek Crossing for hydraulic capacity, stability, safety, and condition.

The Respondents shall design improvements or modifications to the existing pipeline or an entirely new pipeline, in accordance with good engineering practice, to achieve the following minimum performance standards and objectives:

- Conveyance of AMD from the reservoir shall be by gravity, and the pipeline shall provide a capacity of 4,000 gpm to allow fast reservoir drawdown and enhanced operational flexibility. Respondents shall perform an analysis of the hydraulic capacity and stability of the existing pipeline to examine the feasibility of relying on the existing pipeline to provide this service. If the Respondents' analysis indicates that the existing pipeline is stable but that it cannot provide for conveyance of flows as great as 4,000 gpm (but can convey flows in excess of the minimum design capacity of 2,750 gpm), then EPA will evaluate the implementability, effectiveness, reliability and cost-effectiveness of relying on the existing pipeline over the cost of replacement in considering whether to revise this design criteria. EPA may revise this design criteria without revising this SOW or order.

- Respondents shall conduct an engineering investigation and evaluation to determine the whether the existing pipeline is in full conformance with all design requirements approved by EPA for that pipeline. The pipeline failed this past winter and extensive repairs were implemented without notice to or oversight by EPA.

- Analyses shall be conducted pertaining to the long-term reliability and adequacy of the constructed welded-wire retaining walls to support heavy construction traffic loading. Reconstruction of the welded-wire walls may be required if the analyses show the road to be insufficient for heavy construction traffic loading. The analyses and report shall be conducted by a professional geotechnical engineer registered in the State of California.

- The Jeep Trail roadway shall be reconstructed and realigned to ensure continuous access for all weather conditions. A minimum of two additional turnouts shall be constructed on the Jeep trail roadway to allow safe access to the dam area.

- All culverts necessary for protecting the Jeep Trail from erosion shall be designed in a manner to prevent sediment clogging of the culverts during all weather conditions

and erosion of the discharge points at the culvert outlets. Erosion protection shall be provided by a robust design approach to minimize or eliminate the need for future maintenance.

If a new pipeline is required, the Respondents shall design the pipeline to achieve the following minimum requirements:

- The pipeline shall be constructed within roadways.
- The pipeline shall provide a minimum capacity of 4,000 gpm to enhance operational flexibility and to permit rapid reservoir drawdown. Repondends shall conduct an engineering analysis to determine pipeline options. If Respondents desire to construct a new pipeline with a capacity less than 4,000 gpm, Respondents shall provide detailed engineering information justifying the reliance on the lower capacity pipeline and EPA will review appropriateness of relying a a pipeline of the capacity proposed by the Respondents.
- The pipeline shall be constructed of HDPE, minimum SDR 17.
- The pipeline shall be wrapped for secondary containment similar to the existing pipeline and have leak detection at minimum intervals of 500 feet.
- The pipeline trench and construction detail shall be similar to those of the existing pipeline.

5.1.2 Preliminary Design and Engineering Analysis

Preliminary Design begins with the initial design and ends with the completion of approximately 30 percent of the design effort. The Respondents shall provide supporting data, engineering calculations and other documentation with the design documents to define the functional aspects of the project to prove that the completed project will be effective in meeting the performance standards and objectives and all ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit to EPA the Preliminary Design Submittal, which shall, as a minimum, consist of the following, and which shall provide additional information as necessary to define the Preliminary Design:

- The draft Design Criteria Report - The report shall define in detail the technical parameters upon which the design will be based. Specifically, the draft Design Criteria Report shall include the preliminary design assumptions and parameters, including topographic survey, geologic mapping, geotechnical investigation of existing pipeline alignment, stability evaluation along existing alignment, hydraulic evaluation to provide a conveyance capacity of 4,000 gpm (and if necessary an analysis of the existing pipeline reliably convey flows above the current minimum deisgn capacity of 2,750 gpm), evaluation of the condition of the existing pipeline,

replacement pipeline location and criteria, concepts for coordination for road repair with pipeline repair, and pipeline alignment and cross section.

- The draft engineering evaluation report of the hydraulic capacity of the existing pipeline to provide a conveyance capacity of 4,000 gpm, (and if necessary an analysis of the existing pipeline reliably convey flows above the current minimum design capacity of 2,750 gpm), an analysis of the stability of the existing Slickrock Creek AMD pipeline system, and an analysis of the conformance of the recently repaired Slickrock Creek AMD pipeline system, in its current condition, to the original design drawings, specifications and criteria.
- The Preliminary Design EA Reports (Survey, Geology, Hydrology, Hydraulic, Stability and Geotechnical);
- The preliminary Design engineering calculations;.
- The Preliminary Recommended Project Delivery Strategy and Scheduling - The schedule shall include an evaluation of a phased approach to expedite the RA.
- Preliminary Construction Schedule.
- Preliminary Environmental Control Measures Plan - The Plan shall provide plans for dust control, erosion control, slope stabilization, drainage control, and sedimentation control.
- Preliminary Construction Quality Assurance and Quality Control Plan - The Plan shall provide plans for materials testing, inspector(s) qualifications and duties, inspection/testing frequencies, reporting, laboratory certifications, and problem identification and Corrective measures.
- Specifications Outline and Drawings List.
- Preliminary Cost Estimate.
- Preliminary Drawings - Engineering drawings shall be submitted in full-size and one-half-size reproductions.
- Preliminary Identification of long-lead procurement items

As part of the Preliminary Design effort, Respondents shall attend:

- an informal one-day working design review meeting with EPA near the beginning of the performance of the Preliminary Design for the purpose of Respondents presenting descriptions of the initial design aspects and features that are expected

to form the basis of the proposed Preliminary Design.

- a two-day meeting to present the Preliminary Design Submittal (approximate 30 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Preliminary Design Submittal (including the draft Preliminary Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA. Within fourteen (14) days from the receipt of EPA's written comments on the draft Design Criteria Report, Respondents shall revise the draft Design Criteria Report to incorporate all EPA review comments and submit a Pre-final Design Criteria Report to EPA for review and approval. Within seven (7) days after approval by EPA, Respondents shall finalize the Design Criteria Report and submit the report to EPA. Within fourteen (14) days from the receipt of EPA's written comments on the draft engineering report that evaluates the hydraulic capacity of the existing pipeline to provide a conveyance capacity of 4,000 gpm (and if necessary an analysis of the existing pipeline reliably convey flows above the current minimum design capacity of 2,750 gpm), an analysis of the stability of the existing Slickrock Creek AMD pipeline system, and an analysis of the conformance of the recently repaired Slickrock Creek AMD pipeline system, in its current condition to the original design drawings, specifications and criteria. Respondents shall revise the draft engineering evaluation to incorporate all EPA review comments and submit the pre-final engineering evaluation report to EPA for review and approval. Within seven (7) days after approval by EPA, Respondents shall finalize the engineering evaluation report and submit the report to EPA.

5.1.3 Intermediate Design (50 Percent) Submittal

Intermediate Design begins with completion of the Preliminary Design and ends with the completion of approximately 50 percent of the design effort. The Intermediate Design Submittal shall be made after Respondents have provided responses to EPA comments on the Preliminary Design Submittal. EPA's comments on the Preliminary Design Submittal (including the draft Preliminary Design EA Reports) shall be incorporated into the Intermediate Design. The Respondents shall provide supporting data, engineering calculations and documentation with the design documents to define the functional aspects of the project that demonstrate that the completed project will be effective in meeting the performance standards and objectives and all ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit,

for EPA review and approval, the Intermediate Design Submittal, which shall consist of the following:

- The draft Intermediate Design EA Reports (Survey, Geology, Hydrology, Hydraulic, Stability and Geotechnical). The reports shall incorporate any changes since the 30 percent draft Preliminary Design Survey, Geology, and Hydrology Reports.
- Intermediate Design engineering calculations. The calculations shall incorporate any changes since the Preliminary Design (approximate 30 percent).
- Revised Project Delivery Strategy and Schedule;
- Revised Construction Schedule;
- Revised Design Environmental Control Measures Plan;
- Revised Construction Quality Assurance and Quality Control Plan;
- Intermediate Design Specifications;
- Intermediate Design Drawings - The drawings shall be to true scale to fully describe the project and shall present sufficient information to clearly describe the project and reflect organization and clarity. Engineering drawings shall be submitted in full-size and one-half-size reproductions;
- Revised Cost Estimate;

As part of the Intermediate Design effort Respondents shall attend:

- One one-day informal design review meeting with EPA during the performance of the Intermediate Design for the purpose of presenting descriptions of the design aspects and features being incorporated. The meeting shall be held about halfway through Intermediate Design. The schedule for this meeting shall be described in the PDA; and
- One two-day meeting to present the Intermediate Design Submittal (approximate 50 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Intermediate Design Submittal (including the draft Intermediate Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the

change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

5.1.4 Pre-final Design (90 Percent) and Final Design (100 Percent) Submittals

The Respondents shall submit the Pre-final Design for the Slickrock Creek to Boulder Creek Crossing AMD Conveyance Pipeline for EPA review and approval. The Pre-final Design shall function as the draft version of the Final Design. The Pre-final Design shall address comments generated from the Intermediate Design and clearly show any modifications of the design as a result of incorporation of the comments. After EPA review and comment on the Pre-final Design, Respondents shall incorporate all EPA comments and submit the Final Design. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California. Unless expressly authorized by EPA, Respondents shall not initiate RA activities purusant to this Order until EPA approves the Final Design.

The Pre-final Design Submittal shall include the following:

- Pre-final Construction Schedule - The schedule for implementation of the RA shall identify the timing for initiation and completion of all critical path tasks. The schedule shall specifically identify duration for completion of the project and major milestones.
- Pre-final Design Specifications and Pre-final Drawings - A complete set of construction drawings and specifications (general specifications, drawings, and schematics) shall be submitted at the Pre-final stage. All specifications shall conform to Construction Specification Institute (CSI) format.
- The draft Pre-final Design EA Reports (Survey, Geology, Hydrology, Hydraulic, Stability and Geotechnical). The reports shall incorporate any changes since the Intermediate Design (approximate 50 percent).
- The Pre-final Design engineering calculations. The calculations shall incorporate any changes since the Intermediate Design (approximate 50 percent).
- Pre-final RA Cost Estimate.
- Pre-final Project Delivery Strategy.

As part of the Pre-final Design effort Respondents shall attend:

- one two-day meeting to present the Pre-final Design Submittal (approximate 90 percent design) to EPA, including participation by Respondents' key design staff, approximately one (1) week after submittal.

This design review meeting may be held in conjunction with other design reviews

performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Pre-final Design Submittal (including the draft Pre-final Design EA Reports). Within fourteen (14) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

The Final Design Submittal shall incorporate all EPA comments on the Pre-final Design Submittal, implement all design changes required by EPA, and include the following:

- Final Construction Schedule
- Final Design Specifications and Final Drawings - The final submittals shall include a complete set of full-size construction drawings and specifications as well as a set of one-half-size reductions of drawings. All Final Design Specifications and Final Drawings shall be approved, sealed, and signed by a Professional Engineer registered in California.
- The Final Design EA Reports (Survey, Geology, Hydrology, Hydraulic, Stability and Geotechnical). The reports shall incorporate any changes since the Pre-final Design (approximate 90 percent). The Final Design EA Reports shall be approved, sealed, and signed by a Professional Engineer registered in California.
- The Final Design engineering calculations. The calculations shall incorporate any changes since the Pre-final Design (approximate 90 percent).
- Final RA Cost Estimate.
- Final Project Delivery Strategy.

5.2 Acid Mine Drainage Conveyance System - Boulder Creek Crossing to Minnesota Flats Treatment Plant

5.2.1 Performance Standards and Objectives

A second pipeline is required from Boulder Creek Crossing to the Minnesota Flats Treatment Plant for conveyance of the reservoir discharge.

In accordance with good engineering practice, Respondents shall design the new AMD Conveyance system between Boulder Creek Crossing and Minnesota Flats Treatment Plant to achieve the following performance standardsand objectives:

- The pipeline shall be constructed within the roadway.
- The pipeline shall provide a minimum capacity of 4,000 gpm. If the engineering analysis performed by Respondents, pursuant to Section 5.1 of this SOW, demonstrates that: 1) it is not possible to convey 4,000 gpm in the existing Slickrock Creek pipeline (with necessary modifications); 2) that the existing pipeline can reliably convey AMD flows greater than the minimum design capacity of 2,750 but less than 4,000 gpm; and 3) EPA determines that it would not be implementable, effective, reliable and cost-effective to construct a new pipeline in comparison to reliance on the modified existing pipeline, then the pipeline in this area shall be designed to convey flows equal to the maximum design capacity of the existing Slickrock Creek AMD pipeline.
- The pipeline shall be constructed of HDPE, minimum SDR 17.
- The pipeline shall be wrapped for secondary containment similar to the existing pipeline and have leak detection at the same locations as the existing pipeline.
- The pipeline trench and construction detail shall be similar to those of the existing pipeline, except bypass risers shall not be installed.
- A cross-connection with manual valving shall be provided in the vicinity of Boulder Creek Crossing to allow conveyance of the combined Richmond/Lawson portal AMD in the new pipeline, or the conveyance of Slickrock Creek Reservoir AMD in the old pipeline.
- An emergency bypass shall be provided to the Boulder Creek Copper Cementation Plant (BCCP) and around the BCCP (for those times when the AMD flow in the pipe is dilute and cannot effectively be treated by copper cementation) for the new pipeline. An evaluation of the hydraulic capacity of the BCCP shall be performed, and if it is determined that the plant cannot pass a minimum of 4,000 gpm, then the capacity shall be upgraded or the plant rebuilt.
- Provide diversion piping with valving to and from the existing emergency storage tank (Mod-U-Tank) and any future equalization tank when such tank is constructed.

5.2.2 Preliminary Design and Engineering Analysis

Preliminary Design begins with the initial design and ends with the completion of approximately 30 percent of the design effort. The Respondents shall provide supporting data, engineering calculations and other documentation with the design documents to define the functional aspects of the project to prove that the completed project will be effective in meeting the remediation goals and ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit to EPA the Preliminary Design, which shall, as a minimum, consist of the following, and which shall

provide additional information as necessary to define the Preliminary Design:

- The draft Design Criteria Report - The report shall define in detail the technical parameters upon which the design will be based. Specifically, the Design Criteria Report shall include at a minimum the preliminary design assumptions and parameters, alignment criteria, bedding criteria, materials of construction, jointing requirements, air-vacuum relief requirements, and requirements for leak detection.
- The Preliminary Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Hydraulic and Stability).
- The preliminary Design engineering calculations.
- The recommended Preliminary Project Delivery Strategy and Scheduling. The schedule shall include an evaluation of a phased approach to expedite the RA.
- Preliminary Construction Schedule.
- Preliminary Environmental Control Measures Plan - The Plan shall provide plans for dust control, erosion control, slope stabilization, drainage control, and sedimentation control.
- Preliminary Construction Quality Assurance and Quality Control Plan - The Plan shall provide plans for materials testing, inspector(s) qualifications and duties, inspection/testing frequencies, reporting, laboratory certifications, and problem identification and corrective measures.
- Specifications Outline and Drawings List.
- Preliminary Cost Estimate.
- Preliminary Drawings - Engineering drawings shall be submitted in full-size and one-half-size reproductions.
- Preliminary Identification of long-lead procurement items.

As part of the Preliminary Design effort, Respondents shall attend:

- an informal one-day working design review meeting with EPA near the beginning of the performance of the Preliminary Design for the purpose of Respondents presenting descriptions of the initial design aspects and features that are expected to form the basis of the proposed Preliminary Design.
- a two-day meeting to present the Preliminary Design Submittal (approximate

30 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Preliminary Design Submittal (including the draft Preliminary Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA. Within fourteen (14) days from the receipt of EPA's written comments on the draft Design Criteria Report, Respondents shall revise the draft Design Criteria Report to incorporate all EPA review comments and submit a Pre-final Design Criteria Report to EPA for review and approval. Within seven (7) days after approval by EPA, Respondents shall finalize the Design Criteria Report and submit the report to EPA.

5.2.3 Intermediate Design (50 Percent) Submittal

Intermediate Design begins with completion of the Preliminary Design and ends with the completion of approximately 50 percent of the design effort. The Intermediate Design Submittal shall be made after Respondents have provided responses to EPA comments on the Preliminary Design Submittal. EPA's comments on the Preliminary Design Submittal shall be incorporated into the Intermediate Design. The Respondents shall provide supporting data, engineering calculations and documentation with the design documents to define the functional aspects of the project that demonstrate that the completed project will be effective in meeting the performance standards and objectives and all ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit, for EPA review and approval, the Intermediate Design Submittal, which shall consist of the following:

- The draft Intermediate Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Hydraulic and Stability) . The reports shall incorporate any changes since the Preliminary Design (approximate 30 percent).
- Intermediate Design engineering calculations. The calculations shall incorporate any changes since the Preliminary Design (approximate 30 percent).
- Revised Project Delivery Strategy and Schedule;
- Revised Construction Schedule;
- Revised Design Environmental Control Measures Plan;

- Revised Construction Quality Assurance and Quality Control Plan;
- Intermediate Design Specifications;
- Intermediate Design Drawings - The drawings shall be to true scale to fully describe the project and shall present sufficient information to clearly describe the project and reflect organization and clarity. Engineering drawings shall be submitted in full-size and one-half-size reproductions;
- Revised Cost Estimate; and
- Revised Identification of long-lead procurement items.

As part of the Intermediate Design effort Respondents shall attend:

- One one-day informal design review meeting with EPA during the performance of the Intermediate Design for the purpose of presenting descriptions of the design aspects and features being incorporated. The meeting shall be held about halfway through Intermediate Design. The schedule for this meeting shall be described in the PDA; and
- One two-day meeting to present the Intermediate Design Submittal (approximate 50 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Intermediate Design Submittal (including the draft Intermediate Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

5.2.4 Pre-final Design (90 Percent) and Final Design (100 Percent) Submittals

The Respondents shall submit the Pre-final Design for the AMD conveyance pipeline from the Boulder Creek Crossing to the IMM HDS/ASM lime neutralization treatment plant at Minnesota Flats for EPA review and approval. The Pre-final Design shall function as the draft version of the Final Design. The Pre-final Design shall address comments generated from the Intermediate Design and clearly show any modifications of the design as a result of incorporation of the comments. After EPA review and comment on the Pre-final Design, Respondents shall incorporate all EPA comments and submit the Final Design. All Final Design documents shall be approved, sealed,

and signed by a Professional Engineer registered in California. Unless expressly authorized by EPA, Respondents shall not initiate RA activities purusant to this Order until EPA approves the Final Design.

The Pre-final Design Submittal shall include the following:

- Pre-final Construction Schedule - The schedule for implementation of the RA shall identify the timing for initiation and completion of all critical path tasks. The schedule shall specifically identify duration for completion of the project and major milestones.
- Pre-final Design Specifications and Pre-final Drawings - A complete set of construction drawings and specifications (general specifications, drawings, and schematics) shall be submitted at the Pre-final stage. All specifications shall conform to Construction Specification Institute (CSI) format.
- The draft Pre-final EA Reports (Survey, Geology, Hydrology, Geotechnical, Hydraulic and Stability). The reports shall incorporate any changes since the 50 percent draft Intermediate Design.
- The Pre-final Design engineering calculations. The calculations shall incorporate any changes since the 50 percent draft Intermediate Design.
- Pre-final RA Cost Estimate.
- Pre-final Project Delivery Strategy.

As part of the Pre-final Design effort Respondents shall attend:

- one two-day meeting to present the Pre-final Design Submittal (approximate 90 percent design) to EPA, including participation by Respondents' key design staff, approximately one (1) week after submittal.

This design review meeting may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Pre-final Design Submittal (including the draft Pre-final Design EA Reports). Within fourteen (14) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

The Final Design Submittal shall incorporate all EPA comments on the Pre-final Design

Submittal, implement all design changes required by EPA, and include the following:

- Final Construction Schedule
- Final Design Specifications and Final Drawings - The final submittals shall include a complete set of full-size construction drawings and specifications as well as a set of one-half-size reductions of drawings. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California.
- The Final Design EA Reports (Survey, Geology, Hydrology, Geotechnical, Hydraulic and Stability). The reports shall incorporate any changes since the 90 percent draft Intermediate Design. The Final Design EA Reports shall be approved, sealed, and signed by a Professional Engineer registered in California.
- The Final Design engineering calculations. The calculations shall incorporate any changes since the 50 percent draft Intermediate Design.
- Final RA Cost Estimate.
- Final Project Delivery Strategy.

6.0 DESIGN ACTIVITIES - MINNESOTA FLATS TREATMENT PLANT MODIFICATIONS

6.1 Minnesota Flats Treatment Plant Modifications

6.1.1 Performance Standards and Objectives

The Respondents shall implement upgrades to the Minnesota Flats Treatment Plant in accordance with good engineering practice to achieve the following performance standards and objectives:

- Upgrade the inlet box so that the new pipeline can be added and increase the capacity of the associated inlet and discharge piping for a minimum of 6,500 gpm.
- Provide flow measurement on the new pipeline into the inlet box for flows up to a minimum of 5,000 gpm.
- The hydraulic capacity between Reactors TK-1 and TK-2, from TK-1 to the thickener feed trough, and from TK-2 to the thickener feed trough shall be increased to accommodate 10,000 gpm. The fluid viscosity used for design should be consistent with operational experience, and a value of 50 centipoise shall be used unless a more appropriate value can be demonstrated to the satisfaction of EPA.
- The pipeline connecting TK-1 to TK-2 shall consist of a top-connecting pipeline with a minimum capacity of 10,000. The pipeline shall be sized and constructed to allow open channel flow through the pipeline. The invert elevation of the pipeline shall be designed and constructed to minimize the reduction in retention time. The design and construction of the conveyance shall provide for a minimum of 2 feet of reactor freeboard (measured down from the top of tank not including splash guards) at 10,000 gpm throughput is aerated at 2,100 scfm. The new pipeline shall be designed and constructed with similar valving and flush water connections as the existing pipeline.
- Respondents shall size and construct a diversion pipeline to bypass TK-2 and to carry the discharge from TK-1 to the thickener feed trough for 10,000 gpm throughput. Respondents shall configure the pipeline in a similar manner to the existing pipeline.
- The upflow discharge riser in each reactor shall be sized to accommodate the 10,000 gpm throughput and so that the differential fluid level between the bulk reactor contents when aerated and within the reactors is less than 4 inches. The bottom of the risers shall be located at the same elevations as the existing risers and the tops of the risers shall be even with the top of the reactor outlets.
- Respondents shall provide splash protection to accommodate 10,000 gpm

throughput aerated at 2,100 scfm. The splash protection shall prevent oor minimize splash out of the reactors either up through the deck or over the sides, and out of the thickener feed trough.

6.1.2 Preliminary Design and Engineering Analysis

Preliminary Design begins with the initial design and ends with the completion of approximately 30 percent of the design effort. The Respondents shall provide supporting data, engineering calculations and other documentation with the design documents to define the functional aspects of the project to prove that the completed project will be effective in meeting the remediation goals and ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit to EPA the Preliminary Design, which shall, as a minimum, consist of the following, and which shall provide additional information as necessary to define the Preliminary Design:

- The draft Design Criteria Report - The report shall define in detail the technical parameters upon which the design will be based. Specifically, the Design Criteria Report shall include at a minimum the preliminary design assumptions and parameters, materials of construction, modifications to be made to existing facilities, new components and features to be added, design criteria for systems to control splash, and criteria for routing/placement of pipelines and related appurtenances.
- The draft Preliminary Design EA Reports (Hydraulic Evaluation, Structural and Materials of Construction).
- The preliminary Design engineering calculations.
- The recommended Preliminary Project Delivery Strategy and Scheduling - The schedule shall include an evaluation of a phased approach to expedite the RA.
- Preliminary Construction Schedule.
- Preliminary Environmental Control Measures Plan - The Plan shall provide plans for dust control, erosion control, slope stabilization, drainage control, and sedimentation control.
- Preliminary Construction Quality Assurance and Quality Control Plan - The Plan shall provide plans for materials testing, inspector(s) qualifications and duties, inspection/testing frequencies, reporting, laboratory certifications, and problem identification and corrective measures.
- Specifications Outline and Drawings List.
- Preliminary Cost Estimate.
- Preliminary Drawings - Engineering drawings shall be submitted in full-size and

one-half-size reproductions.

- Preliminary identification of long-lead procurement items.

As part of the Preliminary Design effort, Respondents shall attend:

- an informal one-day working design review meeting with EPA near the beginning of the performance of the Preliminary Design for the purpose of Respondents presenting descriptions of the initial design aspects and features that are expected to form the basis of the proposed Preliminary Design.

- a two-day meeting to present the Preliminary Design Submittal (approximate 30 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Preliminary Design Submittal (including the draft Preliminary Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA. Within fourteen (14) days from the receipt of EPA's written comments on the draft Design Criteria Report, Respondents shall revise the draft Design Criteria Report to incorporate all EPA review comments and submit a Pre-final Design Criteria Report to EPA for review and approval. Within seven (7) days after approval by EPA, Respondents shall finalize the Design Criteria Report and submit the report to EPA.

6.1.3 Intermediate Design (50 Percent) Submittal

Intermediate Design begins with completion of the Preliminary Design and ends with the completion of approximately 50 percent of the design effort. The Intermediate Design Submittal shall be made after Respondents have provided responses to EPA comments on the Preliminary Design Submittal. EPA's comments on the Preliminary Design Submittal shall be incorporated into the Intermediate Design. The Respondents shall provide supporting data, engineering calculations and documentation with the design documents to define the functional aspects of the project that demonstrate that the completed project will be effective in meeting the performance standards and objectives and all ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit, for EPA review and approval, the Intermediate Design Submittal, which shall consist of the following:

- The draft Intermediate Design EA Reports (Hydraulic Evaluation, Structural and

Materials of Construction). The reports shall incorporate any changes since the Preliminary Design (approximate 30 percent).

- Intermediate Design engineering calculations. The calculations shall incorporate any changes since the Preliminary Design (approximate 30 percent).
- Revised Project Delivery Strategy and Schedule;
- Revised Construction Schedule;
- Revised Design Environmental Control Measures Plan;
- Revised Construction Quality Assurance and Quality Control Plan;
- Intermediate Design Specifications;
- Intermediate Design Drawings - The drawings shall be to true scale to fully describe the project and shall present sufficient information to clearly describe the project and reflect organization and clarity. Engineering drawings shall be submitted in full-size and one-half-size reproductions;
- Revised Cost Estimate;
- Revised Identification of long-lead procurement items; and

As part of the Intermediate Design effort Respondents shall attend:

- One one-day informal design review meeting with EPA during the performance of the Intermediate Design for the purpose of presenting descriptions of the design aspects and features being incorporated. The meeting shall be held about halfway through Intermediate Design. The schedule for this meeting shall be described in the PDA; and
- One two-day meeting to present the Intermediate Design Submittal (approximate 50 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Intermediate Design Submittal (including the draft Intermediate Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

6.1.4 Pre-final Design (90 Percent) and Final Design (100 Percent) Submittals

The Respondents shall submit the Pre-final Design for the implementation of the Minnesota Flats Treatment Plant Modifications for EPA review and approval. The Pre-final Design shall function as the draft version of the Final Design. The Pre-final Design shall address comments generated from the Intermediate Design and clearly show any modifications of the design as a result of incorporation of the comments. After EPA review and comment on the Pre-final Design, Respondents shall incorporate all EPA comments and submit the Final Design. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California. Unless expressly authorized by EPA, Respondents shall not initiate RA activities purusant to this Order until EPA approves the Final Design.

The Pre-final Design Submittal shall include the following:

- Pre-final Construction Schedule - The schedule for implementation of the RA shall identify the timing for initiation and completion of all critical path tasks. The schedule shall specifically identify duration for completion of the project and major milestones.

- Pre-final Design Specifications and Pre-final Drawings - A complete set of construction drawings and specifications (general specifications, drawings, and schematics) shall be submitted at the Pre-final stage. All specifications shall conform to Construction Specification Institute (CSI) format.

- The draft Pre-final Design EA Reports (Hydraulic Evaluation, Structural and Materials of Construction). The reports shall incorporate any changes since the 50 percent draft Intermediate Design.

- The Pre-final Design engineering calculations. The calculations shall incorporate any changes since the 50 percent draft Intermediate Design.

- Pre-final RA Cost Estimate.

- Pre-final Project Delivery Strategy.

As part of the Pre-final Design effort Respondents shall attend:

- one two-day meeting to present the Pre-final Design Submittal (approximate 90 percent design) to EPA, including participation by Respondents' key design staff, approximately one (1) week after submittal.

This design review meeting may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Pre-final Design Submittal (including the draft Pre-final Design EA Reports). Within fourteen (14) days from the receipt of

EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

The Final Design Submittal shall incorporate all EPA comments on the Pre-final Design Submittal, implement all design changes required by EPA, and include the following:

- Final Construction Schedule
- Final Design Specifications and Final Drawings - The final submittals shall include a complete set of full-size construction drawings and specifications as well as a set of one-half-size reductions of drawings. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California.
- The Final Design EA Reports (Hydraulic Evaluation, Structural and Materials of Construction). The reports shall incorporate any changes since the 90 percent draft Pre-final Design. The Final Design EA Reports shall be approved, sealed, and signed by a Professional Engineer registered in California.
- The Final Design engineering calculations. The calculations shall incorporate any changes since the Pre-final Design (approximate 90 percent).
- Final RA Cost Estimate.
- Final Project Delivery Strategy.

6.2 Treated Water Discharge System

6.2.1 Performance Standards and Objectives

In accordance with good engineering practice, Respondents shall design and construct a treated water discharge system at the IMM HDS/ASM lime neutralization treatment plant located at Minnesota Flats to achieve the following performance standards and objectives:

- Respondents shall design a tunnel between the thickener and Lower Spring Creek below the diversion to allow gravity flow of thickener overflow to the creek. This tunnel shall be capable of containing an HDPE carrier pipeline (minimum SDR 17) able to accommodate 10,000 gpm.
- The tunnel outlet shall be protected from erosion caused by high Spring Creek flows with the diversion to Flat Creek closed.
- Respondents shall design and construct erosion protection of the of the ground

between the tunnel discharge and the creek invert shall be provided.

- A new thickener effluent dropout box similar to the existing box shall be constructed near the inlet of the tunnel. A pipeline from the box to the tunnel shall be installed under the road. A flowmeter (magnetic), a pH meter, and a turbidity meter shall be installed with both local and remote (PLC) readout. A composite sampler shall be provided.

- Valves shall be installed in the discharge pipeline to the tunnel and in the existing thickener discharge pipe from the existing thickener effluent dropout box to allow selective discharge to the existing effluent pump station.

- The existing thickener effluent dropout box shall be modified to prevent deposition of solids and to preserve usability so that flow can be directed to the filtrate pump station.

6.2.2 Preliminary Design and Engineering Analysis

Preliminary Design begins with the initial design and ends with the completion of approximately 30 percent of the design effort. The Respondents shall provide supporting data, engineering calculations and other documentation with the design documents to define the functional aspects of the project to prove that the completed project will be effective in meeting the performance standards and objectives and all ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit to EPA the Preliminary Design, which shall, as a minimum, consist of the following, and which shall provide additional information as necessary to define the Preliminary Design:

- The draft Design Criteria Report - The draft report in detail the technical parameters upon which the design will be based. Specifically, the Design Criteria Report shall include at a minimum the tunnel alignment criteria, the hydraulic capacity criteria, instrumentation criteria, inlet and outlet design criteria, materials of construction, and a list of construction techniques and a discussion of each.

- The draft Preliminary Design EA Reports (Survey, Geology, Geotechnical, Hydraulic and Geotechnical).

- The Preliminary Design engineering calculations.

- The recommended Preliminary Project Delivery Strategy and Scheduling - The schedule shall include an evaluation of a phased approach to expedite the RA.

- Preliminary Construction Schedule.

- Preliminary Environmental Control Measures Plan - The Plan shall provide plans for

dust control, erosion control, slope stabilization, drainage control, and sedimentation control.

- Preliminary Construction Quality Assurance and Quality Control Plan - The Plan shall provide plans for materials testing, inspector(s) qualifications and duties, inspection/testing frequencies, reporting, laboratory certifications, and problem identification and corrective measures.
- Specifications Outline and Drawings List.
- Preliminary Cost Estimate.
- Preliminary Drawings - Engineering drawings shall be shall be submitted in full-size and one-half-size reproductions.
- Preliminary identification of long-lead procurement items.

As part of the Preliminary Design effort, Respondents shall attend:

- an informal one-day working design review meeting with EPA near the beginning of the performance of the Preliminary Design for the purpose of Respondents presenting descriptions of the initial design aspects and features that are expected to form the basis of the proposed Preliminary Design.
- a two-day meeting to present the Preliminary Design Submittal (approximate 30 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Preliminary Design Submittal (including the draft Preliminary Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA. Within fourteen (14) days from the receipt of EPA's written comments on the draft Design Criteria Report, Respondents shall revise the draft Design Criteria Report to incorporate all EPA review comments and submit a Pre-final Design Criteria Report to EPA for review and approval. Within seven (7) days after approval by EPA, Respondents shall finalize the Design Criteria Report and submit the report to EPA.

6.2.3 Intermediate Design (50 Percent) Submittal

Intermediate Design begins with completion of the Preliminary Design and ends with

the completion of approximately 50 percent of the design effort. After Respondents have provided responses to EPA comments on the Preliminary Design Submittal, Respondents shall provide the Intermediate Design Submittal to EPA. Respondents shall incorporate EPA's comments on the Preliminary Design Submittal into the Intermediate Design. The Respondents shall provide supporting data, engineering calculations and documentation with the design documents to define the functional aspects of the project that demonstrate that the completed project will be effective in meeting the performance standards and objectives and all ARARs. In accordance with the schedule established in the PDA, the Respondents shall submit, for EPA review and approval, the Intermediate Design Submittal, which shall consist of the following:

- The draft Intermediate Design (Survey, Geology, Geotechnical, Hydraulic and Geotechnical). The design shall incorporate any changes since the Preliminary Design (approximate 30 percent).
- Intermediate Design engineering calculations. The calculations shall incorporate any changes since the Preliminary Design (approximate 30 percent).
- Revised Project Delivery Strategy and Schedule;
- Revised Construction Schedule;
- Revised Design Environmental Control Measures Plan;
- Revised Construction Quality Assurance and Quality Control Plan;
- Intermediate Design Specifications;
- Intermediate Design Drawings - The drawings shall be to true scale to fully describe the project and shall present sufficient information to clearly describe the project and reflect organization and clarity. Engineering drawings shall be submitted in full-size and one-half-size reproductions;
- Revised Cost Estimate;
- Revised Identification of long-lead procurement items; and

As part of the Intermediate Design effort Respondents shall attend:

- One one-day informal design review meeting with EPA during the performance of the Intermediate Design for the purpose of presenting descriptions of the design aspects and features being incorporated. The meeting shall be held about halfway through Intermediate Design. The schedule for this meeting shall be described in the PDA; and
- One two-day meeting to present the Intermediate Design Submittal (approximate

50 Percent Design) to EPA, including participation of key design staff, approximately one (1) week after submittal.

These two design review meetings may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Intermediate Design Submittal (including the draft Intermediate Design EA Reports). Within twenty-one (21) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

6.2.4 Pre-final Design (90 Percent) and Final Design (100 Percent) Submittals

The Respondents shall submit the Pre-final Design for the implementation of the treated water discharge system for EPA review and approval. The Pre-final Design shall function as the draft version of the Final Design. The Pre-final Design shall address comments generated from the Intermediate Design and clearly show any modifications of the design as a result of incorporation of the comments. After EPA review and comment on the Pre-final Design, Respondents shall incorporate all EPA comments and submit the Final Design. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California. Unless expressly authorized by EPA, Respondents shall not initiate RA activities purusant to this Order until EPA approves the Final Design.

The Pre-final Design Submittal shall include the following:

- Pre-final Construction Schedule - The schedule for implementation of the RA shall identify the timing for initiation and completion of all critical path tasks. The schedule shall specifically identify duration for completion of the project and major milestones.

- Pre-final Design Specifications and Pre-final Drawings - A complete set of construction drawings and specifications (general specifications, drawings, and schematics) shall be submitted at the Pre-final stage. All specifications shall conform to Construction Specification Institute (CSI) format.

- The draft Pre-final Design (Survey, Geology, Geotechnical, Hydraulic and Geotechnical). The design shall incorporate any changes since the 50 percent draft Intermediate Design.

- The Pre-final Design engineering calculations. The calculations shall incorporate any changes since the 50 percent draft Intermediate Design.

- Pre-final RA Cost Estimate.
- Pre-final Project Delivery Strategy.

As part of the Pre-final Design effort Respondents shall attend:

- one two-day meeting to present the Pre-final Design Submittal (approximate 90 percent design) to EPA, including participation by Respondents' key design staff, approximately one (1) week after submittal.

This design review meeting may be held in conjunction with other design reviews performed pursuant to this Order and SOW. The Respondents shall consolidate and respond to EPA's design review comments on the Pre-final Design Submittal (including the draft Pre-final Design EA Reports). Within fourteen (14) days from the receipt of EPA's written comments, Respondents shall provide a written response to each comment. The response shall indicate whether the Respondents have decided to implement a design change as a result of the comment, and how the change will impact the selected remedy, RD/RA costs, and/or schedule. Respondents shall implement all design changes required by EPA.

The Final Design Submittal shall incorporate all EPA comments on the Pre-final Design Submittal, implement all design changes required by EPA, and include the following:

- Final Construction Schedule
- Final Design Specifications and Final Drawings - The final submittals shall include a complete set of full-size construction drawings and specifications as well as a set of one-half-size reductions of drawings. All Final Design documents shall be approved, sealed, and signed by a Professional Engineer registered in California.
- The Final Design (Survey, Geology, Geotechnical, Hydraulic and Geotechnical). The design shall incorporate any changes since the 90 percent draft Pre-final Design. The Final Design EA Reports shall be approved, sealed, and signed by a Professional Engineer registered in California.
- The Final Design engineering calculations. The calculations shall incorporate any changes since the Pre-final Design (approximate 90 percent).
- Final RA Cost Estimate.
- Final Project Delivery Strategy.

7.0 CONSTRUCTION ACTIVITIES

Construction activities shall be guided by the approved Final Designs and Specifications, the PDA, and other Management Plans. Construction activities shall include:

- A Preconstruction Conference shall be held with Respondents, the selected RA Contractor, EPA and other federal, state and local agencies.
- Construction and Construction Quality Assurance/Quality Control (QA/QC) Testing (in accordance with the EPA approved CQAQC Plan);
- Submission of Monthly Construction Progress Reports (in accordance with the requirements of Order 97-16 and this SOW, Section 7.1);
- Prestartup testing (in accordance with the requirements of Order 97-16 and this SOW, Section 7.4);
- Pre-certification Inspection;
- Punch list activities, as necessary;
- Followup Pre-certification inspection(s), as necessary;
- Construction Completion Report (in accordance with the requirements of Order 97-16 and this SOW, Section 7.2);
- Startup/shakedown testing (in accordance with the requirements of Order 97-16 and this SOW, Section 7.4);
- Remedial Action Completion Report;
- System Startup (in accordance with the requirements of Order 97-16 and this SOW, Section 7.3)
- Performance Monitoring Testing (in accordance with the requirements of Order 97-16 and this SOW, Section 7.4).

If the EPA or the Respondents determine that a design modification is necessary during construction, then the Respondents shall prepare and submit to EPA for review and comment a Technical Memorandum which describes the reason for the modification, the proposed changes complete with drawings and sketches, and the estimated cost and schedule impact.

7.1 Monthly Construction Progress Reports

In accordance with the requirements of Order 97-16, Section XV, Respondents shall submit Monthly Construction Progress Reports (on a monthly basis on the 21st day of the month for activities during the previous month) and shall contain the following information:

Project Identifiers:

- Project description;
- Contractor(s);
- Potentially Responsible Parties (PRP) construction management and inspection staff; and
- Contractor(s) construction management and field supervision staff.

Progress Payment:

- Original contract amount;
- Amount paid this month;
- Amount paid to date;
- Percentage complete to date;
- Changes of contract price status;
- Potential modifications;
- Attachment-Monthly Updated Schedule of Values; and
- Attachment-Monthly Updated Change Order Log.

Schedule, Submittals, and Sequence of Work:

- Compilation of daily inspection reports for each work activity
- Compilation of weekly inspection reports for each work activity
- Work completed for previous month;
- Work in progress;
- Work scheduled for next month;
- Substantially completed facilities;
- Milestones achieved this month;
- Change of contract times status;
- Potential progress and weather delays;
- Attachment-Monthly Updated Project Progress Schedule; and
- Attachment-Monthly Update Submittal Log.

Delivery and Inspections:

- Material and equipment delivery status;
- Inspection quality control reports; and
- Construction material testing results.

Health and Safety:

- Minor accidents or Injuries;
- Lost time accidents or Injuries;

- Weekly toolbox meetings; and
- General site housekeeping.

Coordination and Other Items:
- Coordination and conflicts;
- O & M manual development status;
- Operation training plan;
- Manufacturer's services;
- Startup and shakedown activities;
- Visitors on site this month; and
- Record of document development.

7.2 Construction Completion Reports

Respondents shall submit a written Construction Completion Report (CCR),(approved, sealed and signed by a professional engineer registered in the State of California, within 30 days fromthe date of the pre-certification inspection (or followup pre-certification inspection as necessary). In accordance with Order 97-16, Paragraph 62, Construction activities for the Remedial Action (or alternatively for a Component of the Remedial Action) shall be considered complete after submittal to and approval by EPA of the Construction Completion Report for the Remedial Action (or alternatively for a Component of the Remedial Action). The format of the Construction Completion Reports shall be presented in the PDA and shall include the following at a minimum:

- Introduction;
- Revised As-Built Plans and specifications reflecting any modifications made during construction;
- Revised O&M Plan reflecting any changes to operational procedures as a result of any modifications made during construction;
- Construction QA/QC records;
- Summary of design changes implemented by the Technical Memorandum process;
- Revised O&M, as required; and
- Professional Engineer certification that Work has been completed according to design, and that As-Built Drawings are accurate.

The Construction Completion Report for the Remedial Action (or alternatively for each component of the Remedial Action) shall be submitted as a draft CCR to EPA for review and comment, then as a Final CCR, with the Final CCR reflecting and incorporating EPA's comments on the Draft CCR. Additional review and submission

cycles may be required if the originally submitted Final Construction Completion Report does not receive EPA approval.

7.3 Startup/Shakedown Plan

The Respondents shall provide a Startup/Shakedown Plan for the Remedial Action (or alternatively for each Component of the Remedial Action). The Startup/Shakedown Plan (or Plans) shall describe the following:

- Goals and objectives of the startup/shakedown;
- Description of startup/shakedown procedures including a step-by-step list of activities to be conducted;
- List of parameters to measure and/or monitor during startup/shakedown;
- Procedures to terminate and reverse startup/shakedown in a controlled manner; and
- Recording procedures to be used to document startup/shakedown.

The Startup/shakedown Plan (or Plans) shall be submitted as Draft to EPA for review and comment, then as Final, with the Final reflecting and incorporating EPA's comments on the Draft. Additional review and submission cycles may be required if the originally submitted Final Startup/Shakedown Plan (or Plans) do(es) not receive EPA approval.

7.4 Performance Testing Activities

Two types of performance testing shall be conducted. The first type is Performance Verification Testing, and the second type is Performance Monitoring Testing. The overall objective for performance testing activities is to provide performance verification by demonstrating that the constructed systems have achieved and continue to achieve compliance with the Performance Standards and design objectives.

Respondents shall conduct Performance Verification Testing, in accordance with the schedule established in the PDA, to verify that the constructed systems meet Performance Standards and design objectives following construction, and to identify changes that may need to be made to achieve the performance standards and objectives of the Remedial Action.

Respondents shall conduct long-term Performance Monitoring Testing to verify that the systems continue to achieve the performance standards and objectives of the Remedial Action.

Respondents shall commence Performance Testing following EPA approval of the Performance Testing Plan for the Remedial Action (or alternatively, the Performance Test Plan for each component of the Remedial Action).

7.4.1 Performance Testing Plan

The Respondents shall submit a Performance Testing Plan (PTP) for the Remedial Action (or alternatively for each Component of the Remedial Action). The Performance Testing Plan (or Plans) shall be an addendum to the existing Performance Standards Verification Plan (PSVP). The PTP shall describe the procedures to be used to demonstrate performance and guide the performance testing activities and acceptance procedures, and shall describe procedures to be used for long-term performance testing and reporting. The existing PSVP shall be updated to include the provisions of the PTP. The Performance Testing Plan (or Plans) and the updated PSVP shall be submitted at three levels of completeness (Outline, Pre-final, and Final pursuant to the schedule established in the PDA). The Performance Testing Plan (or Plans) shall include, at a minimum:

- Identification of Performance Standards that are subject to performance testing;
- Discussion of overall approach to demonstrating Performance with identified Performance Standards, including the manner in which statistical and temporal variations and non-systemic performance variances will be interpreted;
- Description of the specific monitoring procedures that will demonstrate compliance with Performance Standards, including monitoring frequency within the Performance testing periods;
- Sampling Plans, as necessary;
- Monitoring schedule, taking into account personnel and equipment logistics and integration and coordination with other Site activities;
- Specific coordination procedures for any EPA split or replicate sampling activities;
- Schedule for Performance Testing;
- Documentation and Reporting Procedures;
- Data Quality Objectives for Measurement of Data and QA/QC Procedures; and
- Data Reduction and Validation.

Performance testing for each Subcomponent shall also include monitoring and testing of the following items:

Subcomponent	Item or Component to be Tested or Monitored
Dam Structure, Spillway, Outlet Works	• California DOSOD Standards • Operability of all systems including telemetry, gates, manual overrides, alarms • Outlet works discharge capacity and flow control accuracy • Sampling of reservoir discharge during storm events and high discharge events and testing for total suspended solids (TSS) and particle size
Hematite Pile Retention Structure	• Sampling of structure discharge during storm events and testing for TSS and hematite and any other monitoring appropriate under state mining laws • Documentation of the functionality of the structure and related facilities during storm events and comparison to design intent
Sediment and debris basin(s)	• Sampling of basin discharge during storm events and testing for TSS and particle size
Clean Water Diversion(s)	• Documentation of the functionality of the diversions and related facilities during storm events and comparison to design intent
Other Work	• Documentation of the functionality of the facilities during storm events and other times and comparison to design intent
AMD Conveyance System - Slickrock Creek Reservoir to Boulder Creek Crossing	• Hydraulic capacity testing • Inspection and documentation of the performance of the culverts under the pipeline alignment during storm events and comparison to design intent
AMD Conveyance System - Boulder Creek Crossing to Minnesota Flats Treatment Plant	• Hydraulic capacity testing • Inspection and documentation of the performance of the culverts under the pipeline alignment during storm events and comparison to design intent
Minnesota Flats Treatment Plant Modifications	• Hydraulic capacity testing of new inlet box and process fluid pipelines • Reactor freeboard testing at high flows • Testing of splash protection • Continuation of monitoring requirements per existing PSVP (November 1996)
Treated Water Discharge System	• Evaluation of overall operability of discharge system when operating at high flow rates • Monitoring of outlet at Lower Spring Creek and comparison to design requirements • Testing of relocated sampler • Testing of instrumentation • Testing of discharge to filtrate pump station

7.4.2 Performance Testing Reports

A Performance Testing report shall be submitted by the Respondents for the Remedial Action (or alternatively for each component of the Remedial Action) no later than six (6) weeks after conclusion of each Performance Testing Period. The format of the Performance Testing Report (or Reports for each component of the Remedial Action) shall be presented in the O&M Manual and shall include at a minimum:

- Identification of testing performed and performance goals and requirements;
- A statement as to whether the Performance Testing Period was successful or unsuccessful;
- A summary of monitoring and other activities related to performance testing conducted during the Performance Testing Period;
- A summary of monitoring and other data collected during the Performance Testing Period, including the locations and sampling dates for each data point or set of data points relating to system performance or performance testing; and
- Copies of analytical data and testing field log books

The Performance Testing Report (or Reports for each component of the Remedial Action) shall be submitted as Draft to EPA for review and comment, then as Final, with the Final reflecting and incorporating EPA's comments on the Draft. Additional review and submission cycles may be required if the originally submitted Final Performance Testing Report does not receive EPA approval.

8.0 OPERATIONS AND MAINTENANCE ACTIVITIES

The Respondents shall perform training, operation, maintenance, monitoring and reporting activities for the Remedial Action and each Component of the Remedial Action before, during, and after performance testing to ensure that the systems operate properly and successfully and continue to meet the objectives and the performance standards.

8.1 Slickrock Creek Reservoir Filling Plan

The Respondents shall submit a draft Filling Plan for Slickrock Creek Reservoir for review. The Filing Plan shall include, at a minimum, requirements of the California DOSOD. The Respondents shall incorporate comments on the Draft Filling Plan into the Final Filling Plan and resubmit for review and approval.

8.2 Operation and Maintenance Manuals

In accordance with the requirements of Order 97-16, Paragraph 63, Respondents shall submit O&M manuals and addenda to current O&M manuals for existing structures, equipment or facilities modified by Work performed in this Remedial Action to incorporate provisions for performance of O&M activities for the new or modified structures, equipment or facilities. The O&M manuals shall be submitted as Draft and Final manuals and addenda for review and comment by EPA. These manuals and addenda shall describe startup/shakedown and shutdown procedures, operation, troubleshooting, training, and evaluation activities that shall be carried out by the Respondents. The manuals shall address the following elements:

- Facility overview, including narrative of purpose, description of equipment identification, process description, design criteria, control systems, etc.;
- Step-by-step process and equipment startup/shakedown procedures;
- Normal operation procedures including checklist for routine activities;
- Step-by-step procedures for process and equipment shutdown;
- Schedule and Check List for inspection of each Subcomponent and appurtenances;
- Monitoring schedule for instrumentation;
- Equipment startup/shakedown and operator training;
- Technical specifications governing treatment systems;
- Requirements for providing appropriate service visits by experienced personnel to

supervise the installation, adjustment, startup and operation of the systems; and

- Schedule and procedures for operator training;
- Description of tasks required for system operation;
- Description of tasks required for system maintenance;
- Schedule showing the required frequency for each O&M task;
- Description of potential operating problems;
- Description and analysis of potential operating problems;
- Sources of information regarding problems;
- Common remedies or anticipated corrective actions;
- Manufacturer's O&M Manuals;
- Operational Emergency response;
- Maintenance procedures and schedules;
- Inspection program;
- Parts and equipment inventory;
- Description of alternate O&M; Should system fail, alternate procedures to prevent undue hazard, and analysis of vulnerability and additional resource requirements should a failure occur;
- Safety Plan;
- Description of precautions to be taken and required health and safety equipment, etc., for site personnel protection, and Safety tasks required in the event of systems failure;
- Replacement schedule for equipment and installation components;
- Records and reporting;
- Daily operating logs;
- Records of operating cost;
- Mechanism for reporting emergencies;

- Personnel and Maintenance Records;
- As-built drawings and vendor-supplied drawings; and
- Maintenance Summary Forms.

8.3 O&M Reporting Requirements

Respondents shall comply with all of the reporting requirements specified in Order Nos. 97-16, 94-12, as amended, and 91-07, as amended.

9.0 DELIVERABLES

The Respondents shall submit the deliverables to the following agencies/departments:

U.S. EPA
75 Hawthorne Street
San Francisco, CA 94105
Attn: Rick Sugarek
(2 copies)

Department of Toxic Substances Control
10151 Croydon Way
Sacramento, CA 95827
Attn: Don Mandel
(1 copy)

Division of Dam Safety
Vernon Persson
2200 X Street
Sacramento, CA 95818
Attn: Philip Lee
(1 copy)

CH_2M HILL
2525 Airport Road
Redding, CA 96001
Attn: John Spitzley
(3 copies)

U.S. Bureau of Reclamation
1140 West Wood Street
Willows, CA 95988
Attn: Richard Welsh
(2 copies)

The following items are considered to be deliverables under this Order. Refer to previous sections of this SOW for the requirements of each deliverable.

Predesign:
- Draft Project Delivery Analysis (PDA);
- Draft Final Project Delivery Analysis
- Final Project Delivery Analysis; and
- Health and Safety Plan (HASP).

Design - Dam Structures, Spillway, and Outlet Works:
- Design Criteria Report
- Engineering Analysis Reports;
- Preliminary Design
- Intermediate Design;
- Pre-final Design; and
- Final Design.

Design - Hematite Pile Retention Structure:
- Design Criteria Report
- Engineering Analysis Reports
- Preliminary Design;
- Pre-final Design; and
- Final Design.

Design - Clean Water Diversions:
- Design Criteria Report
- Engineering Analysis Reports
- Engineering Analysis of Existing Clean Water Diversion
- Preliminary Design;
- Intermediate Design
- Pre-final Design; and
- Final Design.

Design - Other Work:
- Design Criteria Report
- Engineering Analysis Reports
- Preliminary Design;
- Intermediate Design
- Pre-final Design; and
- Final Design.

Design - AMD Conveyance form Slickrock Creek to Boulder Creek Crossing:
- Design Criteria Report
- Engineering Analysis Reports
- Engineering Evaluation of Existing Slickrock Creek AMD Pipeline
- Preliminary Design;

- Intermediate Design
- Pre-final Design; and
- Final Design.

Design - AMD Conveyance form Boulder Creek Crossing to the Minnesota Flats Treatment Plant:

- Design Criteria Report
- Engineering Analysis Reports
- Preliminary Design;
- Intermediate Design
- Pre-final Design; and
- Final Design.

Design - Minnesota Flats Treatment Plant Modifications

- Design Criteria Report
- Engineering Analysis Reports
- Preliminary Design;
- Intermediate Design
- Pre-final Design; and
- Final Design.

Design - Treated Water Discharge System:

- Design Criteria Report
- Engineering Analysis Reports
- Preliminary Design;
- Intermediate Design
- Pre-final Design; and
- Final Design.

Construction:

- Monthly Construction Progress Reports;
- Draft Construction Completion Reports (For the Remedial Action or for each component);
- Final Construction Completion Reports (For the Remedial Action or for each component);
- Draft Startup/Shakedown Plans (For the Remedial Action or for each component);
- Final Startup/Shakedown Plans (For the Remedial Action or for each component);
- Outline Performance Testing Plans (For the Remedial Action or for each component);
- Pre-final Performance Testing Plans (For the Remedial Action or for each component);
- Final Performance Testing Plans (For the Remedial Action or for each component);
- Outline Updated Performance Standards Verification Plan (PSVP);

- Pre-final Updated Performance Standards Verification Plan (PSVP);
- Final Updated Performance Standards Verification Plan (PSVP); and
- Draft Performance Testing Reports (For the Remedial Action or for each component);
- Final Performance Testing Reports (For the Remedial Action or for each component);
- Draft Remedial Action Completion Report
- Final Remedial Action Completion Re[port

Operation and Maintenance:

- Monthly Reports
- Draft annual operations, maintenance, and inspection work plan
- Pre-Final annual operations, maintenance, and inspection work plan
- Draft emergency O&M designs and specifications (with supporting engineering calculations)
- Pre-final emergency O&M designs and specifications (with supporting engineering calculations)
- Draft Slickrock Creek Reservoir Filling Plan;
- Final Slickrock Creek Reservoir Filling Plan;
- Draft Operations and Maintenance Manuals (new and addenda to existing O&M Manuals); and
- Final Operations and Maintenance Manuals (new and addenda to existing O&M Manuals).

10.0 SCHEDULE

Table 10-1 provides schedules for the deliverable reports. If EPA determines it is appropriate, the time periods set forth pursuant to this schedule may be extended without requiring a formal modification to this SOW.

TABLE 10-1 - Sample Schedule								
	Slickrock Creek Retention Reservoir				Conveyance Systems		Plant Modifications	
Date	Dam	Hematite Pile	Sediment Basins	Other	Upper Pipeline	Lower Pipeline	Hydraulic Upgrade	Effluent Tunnel
9/30/97	Issue ROD							
10/22/97	draft PDA	draft PDA	draft PDA	draft PDA	draft PDA	draft PDA	draft PDA	draft PDA
11/12/97	final PDA	final PDA	final PDA	final PDA	final PDA	final PDA	final PDA	final PDA
12/15/97					preliminary design	preliminary design	preliminary design	preliminary design
2/1/98	engineering reports	preliminary design	preliminary design	preliminary design				
4/1/97					final design	final design	final design	final design
5/1/98	intermediate design				bid/award	bid/award	bid/award	bid/award
5/15/98					start constuction	start construction	start constuction	start constuction
7/1/98	prefinal design	prefinal design	prefinal design	prefinal design				
10/1/98	final design	final design	final design	final design	construction complete	construction complete	construction complete	construction complete
2/1/99[1]	bid/award	bid/award	bid/award	bid/award				
3/1/99	start construction	start construction	start construction	start construction				
10/1/99	construction complete	construction complete	construction complete	construction complete				

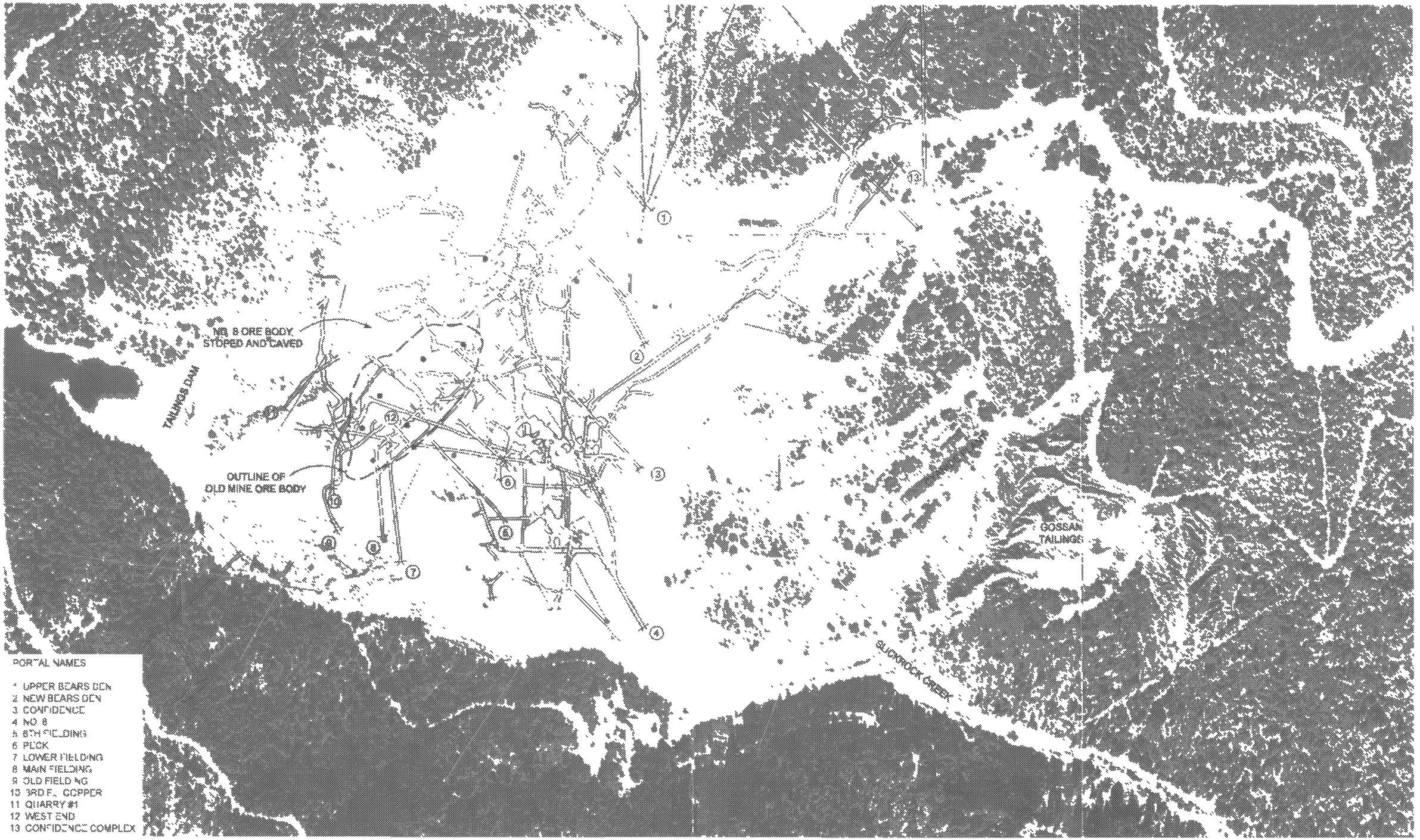
[1]Delay between final design to bid award is to time construction for dry season at the site

11.0 PERFORMANCE STANDARDS

Performance Standards shall be defined to be those cleanup standards, standards of control and other substantive requirements, criteria, or limitations set forth in the 1997 RODand this SOW.

The Respondents shall design and construct the required Work using standard engineering practices and by the requirements of the California DOSOD. The work shall meet or exceed the performance standards and objectives stated in Sections 4.1.1, 4.2.1, 4.3.1, 4.4.1, 5.1.1, 5.2.1, 6.1.1, and 6.2.1.

In addition to the specific items enumerated in those sections, Work must comply with all aplicable or relevant and appropriate requirements (ARARs) for this action. The ARARs for this action are identified in ROD4, which also incorporates by reference the more detailed ARAR discussion from the 1992 ROD for the IMM site. Some of the major ARARs for construction of the retention structure include DOSOD requirements, state seismic requirements and mitigation required pursuant to the Fish & Wildlife Coordination Act. Some of the major ARARs for the construction of the hematite containment structure include state mining laws and state seimic requirements. The ARARs for the design, modification, operation and maintainence of the Minnesota Flats HDS/ASM treatment plant, including but not limited to the effluent standards for the treatment plant, are set forth in the 1992 ROD for the IMM site, which was incorporated by reference into ROD4.


MT. 8 ORE BODY
STOPED AND CAVED
TAILINGS DAM
OUTLINE OF
OLD MINE ORE BODY
GOSSAN
TAILINGS
SLICKROCK CREEK
PORTAL NAMES
1 UPPER BEARS DEN
2 NEW BEARS DEN
3 CONFIDENCE
4 NO. 8
5 6TH FIELDING
6 PUCK
7 LOWER FIELDING
8 MAIN FIELDING
9 OLD FIELDING
10 3RD FL. COPPER
11 QUARRY #1
12 WEST END
13 CONFIDENCE COMPLEX
DRILL HOLES
1959 MT. COPPER CO. BRICKFLAT DIAMOND DRILL MAP (CH0089)
1983 RUSKIN DEVELOPMENTS LTD IRON MT. MINE DRILL HOLE MAP (CH0061 04)
1912 GENERAL SURVEY OF IRON MT. MINE FOR THE MT. COPPER CO. (CH0052 01)
1914 TABULATION OF DIAMOND DRILL HOLES (RIC 0353)
SHAFT WELLS (SHEPARD MILLER 1986)
CAVED ADIT AND WORKINGS
ORE BODIES
LIMIT OF STOPING
LOCATION OF ORE BODIES AND
WORKINGS ESTIMATED FROM KINKEL,
HALL AND ALBERS GEOLOGICAL
SURVEY PAPER 285 PLATE 8
U.S. DEPARTMENT OF INTERIOR
0 100 200 300
FEET
PHOTOGRAPHY DATED 9-3-68
DIGITAL ORTHOPHOTO MEETS NATIONAL
MAP ACCURACY STANDARDS FOR 1" = 200' SCALE
PHOTO EXHIBIT 1
MINE WORKINGS & DRILL HOLES
SLICKROCK CREEK
IRON MOUNTAIN MINE, REDDING, CALIFORNIA

TAILINGS DAM

SLICKROCK CREEK
CLEANWATER DIVERSION

FAST SURFACE
SURFACE WATER
COLLECTION SYSTEM

GOSSAN
TAILINGS

SLICKROCK CREEK
DETENTION DAM

TOE

TOE

SLICKROCK CREEK

APPROXIMATE AREA COLLECTED FOR TREATMENT

APPROXIMATE AREA NOT COLLECTED FOR TREATMENT

PHOTOGRAPHY DATED 6 3 88
DIGITAL ORTHOPHOTO MEETS NATIONAL
MAP ACCURACY STANDARDS FOR 1" = 300' SCALE

0 100 200 300
FEET

N

PHOTO EXHIBIT 2
CONCEPTUAL DEPICTION OF SELECTED REMEDY
SLICKROCK CREEK AREA SOURCES

IRON MOUNTAIN MINE, REDDING, CALIFORNIA